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ABSTRACT

MODIA (Method of Designing Instructional Alternatives) was developed to help the Air Force manage resources for formal training by systematically and explicitly relating quantitative requirements for training resources to the details of course design and course operation during the planning stage. This report explains how to operate the User Interface (UI) component of MODIA; a separate appendix describes the program. The UI program acts as a knowledgeable assistant to course planners by eliciting their judgments about how the course should be designed--specifically, the course objectives, teaching policy, resource characteristics, and student characteristics. The program collates the resulting decisions to develop a comprehensive, internally consistent description of the course in a variety of formats to assist planners in analysis of the course design and in preparing inputs for analysis by the cost model. The UI also produces the course description in the required form for input to the Resource Utilization Model, which analyzes the course operation. (Author/DAG)

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MODIA: Vol. 3
Operation and Design of the User Interface

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Polly Carpenter-Huffman, Misako Fujisaki, Ray Pyles

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prepared for the
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Rand
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PREFACE

This report documents research conducted under Project AIR FORCE (formerly Project RAND) by The Rand Corporation. The work described here was performed as part of the project entitled "Analysis of Systems for Air Force Education and Training" under Rand's Manpower, Personnel, and Training Program. It is the third in a series presenting the MODIA planning system. MODIA, a *M*ethod of *D*esigning *I*nstructional *A*lternatives, is a system of people, computer programs, and procedures that allows the rapid specification and simulation of courses of instruction during the early stages of instructional design. It complements and augments the present Air Force Instructional System Development (ISD) process.

The development of MODIA has been supported by the Deputy Chief of Staff/Personnel, Headquarters United States Air Force, and the Air Training Command, especially DCS/Technical Training, the Training Development Directorate, and personnel at the Keesler Technical School. It is part of Rand's continuing research effort in the areas of planning and management in education, education technology, and the cost and effectiveness of education systems.

This report explains how to operate the User Interface (UI) program, which assimilates the planner's judgments and policies about the course plan. The appendix, published separately, describes the design of the program. The report is directed to those who will use MODIA for course design and to computer systems analysts responsible for the transportation, installation, maintenance, and extension of the MODIA system.

The series of MODIA reports includes:

R-1700-AF, *MODIA: Vol. 1, Overview of a Tool for Planning the Use of Air Force Training Resources*, Polly Carpenter-Huffman.

R-1701-AF, *MODIA: Vol. 2, Options for Course Design*, Polly Carpenter-Huffman.

R-1702-AF, *MODIA: Vol. 3, Operation and Design of the User Interface*, Polly Carpenter-Huffman, Misako Fujisaki, and Ray Pyles.

R-1703-AF, *MODIA: Vol. 4, The Resource Utilization Model*, Margaret Gallegos.

R-1704-AF, *MODIA: Vol. 5, User's Guide to the Cost Model*, Ronald Hess and Phyllis Kantar.

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SUMMARY

This report explains how to operate the User Interface component of MODIA (a *M*ethod *O*f *D*esigning *I*nstructional *A*lternatives); a separate appendix describes the program. MODIA is a system for planning a training course that was developed to help the Air Force improve the management of training resources. It is designed primarily for the use of the five technical training centers of the Air Training Command (ATC). These account for the bulk of technical training, which is a major Air Force activity in that about 25 percent of Air Force personnel graduate annually from formal courses at a cost of over $600 million. Over a third of the 300,000 different course hours in the technical training curriculum are substantially revised or newly prepared annually. Thus, in the normal course of events, ample opportunities arise for improvements in technical training.

MODIA is a systematic process for planning the mix of students, instructors, materials, equipment, and facilities, and the procedures by which all of these elements work together to effect student mastery of the subject matter. MODIA helps planners to create a detailed description of course operation and to derive an estimate of course cost consistent with the description. This encourages planners to devise and compare alternative plans for training courses.

The User Interface program acts as a knowledgeable assistant to course planners by eliciting their judgments about how the course should be designed—specifically, the course objectives, teaching policy, resource characteristics, and student characteristics. To help planners make these judgments, Vol. 2 in this series *(Options for Course Design)* discusses the training-related rationale for the decisions requested by the User Interface; the reader is assumed to have some familiarity with Vol. 2. The program collates these decisions to develop a comprehensive, internally consistent description of the course in a variety of formats to assist planners in analysis of the course design and in preparing inputs for analysis by the cost model. The User Interface also produces the course description in the required form for input to the Resource Utilization Model, which analyzes the course operation.

ACKNOWLEDGMENTS

We wish to thank Kathy Styles for writing the initial version of the User Interface program and Phyllis Kantar for help in expanding the program. Morton Berman and Suzanne Landa contributed useful suggestions for improvement of this report, and Helen Turin's editing clarified it. Judy Smith and Marilyn La Prell shared the chores of preparing the manuscript for typesetting; Sally Belford prepared the pasteup for the printer.

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GLOSSARY

adaptive format: A teaching method that requires the student to respond overtly throughout the instruction to indicate whether he understands, remembers, or can perform what he is being taught. Both the rate at which the instruction is given and the content of the instruction are adjusted to student needs on the basis of these reponses. Tutoring, branching programmed text, and most computer-assisted instruction use the adaptive format. (See **teaching format.**)

adaptive program: A device or machine that presents the subject matter, elicits an overt response from the student, senses the response, and selects the content of the next presentation on the basis of the response. Usually a computer. (See **teaching agent.**)

assumed inventory at start of course: The number of resource units already assigned to a course or able to be drawn from stock or purchased for the use of the course.

audio: A class of media that conveys only audible information—e.g., a phonograph. (See **media class.**)

audio motion visual: A class of media that conveys both audible information and visual information in motion—e.g., a videotape player. (See **media class.**)

audio still visual: A class of media that conveys both audible and visual information, the visual information being in the form of still pictures or print—e.g. a sound-slide set. (See **media class.**)

capacity (of a resource): The maximum number of students that can use or be instructed with a single unit of the resource during a given learning event. The capacity may be different for different learning events. (See **learning event, dedicated resource, shared resource.**)

category (of student): A subclass of the total student population defined on the basis of student ability, some other characteristic, or a combination of the two.

check practice: A type of learning event intended to check the student's mastery of the subject. The results do not directly affect his progress in scheduled instruction. (See **learning event type, test.**)

concurrent adaptability: The extent to which instruction is adapted to student needs in learning while the instruction is in progress.

common-element objective: An objective that is prerequisite to more than one training objective.

constructed response: A response the student must produce or construct himself. Examples are written or typed answers, drawings, and spoken words or phrases. (See **selected response.**)

content diversification: The planned instruction of different categories of students in different subject matter content. MODIA handles this by having students skip entire objectives or parts of objectives. (See **diversification.**)

courseware: Instructional materials prepared for particular learning events and media systems—e.g., a textbook; includes software as a subcategory. (See **software.**)

critique: A learning event following a test during which the instructor discusses the test with the class or individual student. (See **learning event, test.**)

dedicated resource: A resource that may be used in only one section of one learning event at a time. (See **learning event, section.**)

diversification: The provision before the course begins of different approaches to instruction to meet the needs of different categories of students.

entry group: A group of students newly arrived at the course. Does not include recycling students.

entry interval: The time between arrivals of entry groups.

evaluator: A person assigned to rate a student's performance on a check practice or test or to discuss student performance during a critique.

failure: Elimination of a student from the course because of unacceptable performance on a test. (See **test.**)

group discussion: A type of learning event during which a small group of students engages in an interactive discussion of the subject. (See **learning event type.**)

grouping: The separation of students into two or more divisions that are instructed separately. The groups can change their makeup during the course. (See **tracking.**)

guided practice: A type of learning event in which the student receives feedback on his performance as he performs the skill he is learning. (See **learning event type.**)

homework: An assignment for home study. (See **learning event type.**)

Instructional System Development (ISD): "A systematic procedure for assuring application of instructional technology to course planning and development.[1] The five steps of ISD are treated in detail in the five volumes of the *Handbook for Designers of Instructional Systems.*[2]

learning event: A portion of the subject matter that will be taught to a particular category of student in a particular way. May be equivalent to an objective or may be one of a sequence of several activities for teaching an objective. It is also described in terms of the kinds of training resources needed to teach it and the time it will take. (See **learning event type.**)

learning event type: The general instructional function of a learning event in a sequence of events for teaching a particular course objective. Includes presentation/demonstration, guided practice, unguided practice, group discussion, check practice, homework, review, test, and critique.

media class: A group of media systems that represent information in the same general way. Media classes include audio, still visual, motion visual, audio still visual, audio motion visual, and type.

media system: A particular configuration of hardware and media for transmission and display of information. Information may be produced live or recorded.

method diversification: The planned instruction of different categories of students in different ways, either by varying classroom practice (e.g., lecture or self study) or by varying the amount of instruction given, or both. (See **diversification.**)

MODCOM: The *MODIA COst Model*, one of MODIA's computerized components.

MODIA team: A group of people who have been trained and are expert in the use of MODIA.

[1] *Instructional System Development*, Department of the Air Force, AFM 50-2, 31 July 1975, p. 1-1.

[2] *Handbook for Designers of Instructional Systems*, Department of the Air Force, AFP 50-58, 15 July 1973.

monitor: A person who supervises a learning event but does not actively teach it.

motion visual: A class of media that presents information by means of moving pictorial images. (See **media class.**)

objective: A portion of the subject matter. May be a general topic, a specific statement of content (e.g., the nomenclature for parts of a pressure regulator), a criterion-referenced statement of a behavioral objective, or even a division of course time (e.g., first class period).

presentation/demonstration: A type of learning event that presents the facts or concepts the student will be expected to learn or introduces him to the skill he will be expected to master. (See **learning event type.**)

process only (in relation to subject matter type): Student mastery of the skill must be assessed during his performance of the skill. The end result of his performance is no indication of his mastery. (See **subject matter type, product only, product and process.**)

product and process (in relation to subject matter type): Student mastery of the skill can be assessed on the basis of the product of his performance, the process of his performance, or both. (See **subject matter type, process only, product only.**)

product only (in relation to subject matter type): Student mastery of the skill can be assessed only from the product of his performance. (See **subject matter type, process only, process and product.**)

recitation format: A teaching method that requires the student to respond overtly throughout the instruction to indicate whether he understands, remembers, or can perform what he is being taught. (See **teaching format.**)

recycle: The repetition of a portion of the preceding instruction by a student who has performed poorly on a test; washback. (See **test.**)

recycle point: The point to which a recycling student must go back.

resource assignment policy: The combination of learning events by which a given resource will be differentiated or assigned to the course. These assignments can be by the whole course, blocks of sequential learning events, all learning events of a given subject matter type or learning event type, by student track, by individual learning events, various combinations of the foregoing, and none.

Resource Utilization Model (RUM): A simulation of the course operation that includes generation of requirements for training resources by student progress through a course. One of MODIA's computerized components.

response-paced program: A device or machine that presents the subject matter, elicits an overt response from the student, senses the response, and proceeds to the next presentation if the response is correct. Usually a teaching machine. (See **teaching agent.**)

response-paced format: A teaching method that requires the student to respond overtly throughout the instruction to indicate whether he understands, remembers, or can perform what he is being taught. The rate at which the instruction is given is adjusted to student needs on the basis of these responses. (See **teaching format.**)

review: A type of learning event that precedes and is intended to prepare a student for an upcoming test. (See **learning event type, test.**)

section: A single occurrence of a learning event. A number of students (between the minimum and maximum section size) are provided with the training re-

sources required (usually including a single teaching agent) for the section and take the learning event simultaneously. (See **learning event, teaching agent.**)

selected response: The student responds by selecting from a set of prepared responses. Typical examples are multiple choice, true-false, and matching questions. (See **constructed response.**)

shared resource: A resource that for a given learning event may be used simultaneously by students who are in different sections of the learning event or are in sections of other learning events. (See **learning event, section.**)

simple format: A teaching method in which the subject matter is merely presented or demonstrated to the student or the student is directed to perform. (See **teaching format.**)

software: A computer, or otherwise automated, program built to produce or control courseware. (See **courseware.**)

special resource: A resource (facilities, equipment, or material) specific to the subject matter—that is, that would be useful only in teaching a subject very similar to the subject of the course.

still visual: A class of media that conveys visual information in the form of still pictures or print. (See **media class.**)

subject matter expert: A person who understands the subject matter of the course and either knows the student population and the teaching methods that are best for them, or is familiar with school policy, or knows what resources are likely to be available to the course, or has the foregoing knowledge in any combination.

subject matter type: A category of course content that reflects its relative difficulty, whether it concerns skills (as opposed to knowledge), whether it has unusual requirements for resources, and the type of student response that is appropriate for judging mastery of the content.

teaching agent: The person or thing that interacts directly with the student to instruct him. Includes instructors, learners, response-paced programs, and adaptive programs.

teaching format: The method of instruction described in terms of the extent to which it is explicitly structured to involve the student and adapt to his needs while it is going on. Includes simple, recitation, response-paced, adaptive, and group interaction formats.

team (or interactive) skill: A skill that is normally performed in an interactive group or team on the job.

test: A type of learning event intended to evaluate student mastery of preceding instruction. The only type of learning event that can cause students to recycle or be eliminated from the course. (See **learning event type, check practice.**)

total resource capacity: The total number of students a resource type with fixed capacity can accommodate at one time; the product of the number of units of the resource available to the course and the capacity of a single unit of the resource.

tracking: The separation of students into two or more divisions that are instructed separately throughout the course—e.g., a fast track. (See **grouping.**)

type: A class of media that presents one or several alphanumeric characters at a time. Usually a teletype or other computer terminal. (See **media class.**)

unguided practice: A type of learning event in which the student is merely directed to practice or perform the skill he is learning. (See **learning event type.**)

User Interface (UI): An interactive computer program that builds the details of preliminary training course design on the basis of step-by-step input from the user. One of the computer-based components of MODIA.

I. INTRODUCTION

MODIA (a *M*ethod *O*f *D*esigning *I*nstructional *A*lternatives) is a system for planning a training course. Its purpose is to help the Air Force improve the management of training resources. The need for a system like MODIA is discussed at some length in Vol. 1 of this series; this discussion is not repeated here.

ROLE OF THE USER INTERFACE IN MODIA

MODIA has four components: the description of *Options for Course Design* (Vol. 2 of this series), the User Interface (UI), the Resource Utilization Model (RUM), and the Cost Model (MODCOM). Figure 1 shows the interactions between the user and these components. Note that MODIA has two main points for entering data—the UI and MODCOM—rather than automatically translating RUM output into course cost. This is because decisions concerning costing procedures and policies are often contingent on course operation. The additional entry point also permits planners to refine the design for preferred course operation before undertaking a complete cost analysis.

Volume 2, *Options for Course Design* introduces the user to data and information the UI will ask for, the range of choices available at each entry point, and the pros and cons of each choice as it affects course operation, cost, or instructional effectiveness. Since those using the UI will need this guidance, this report assumes the reader is acquainted with the *Options* volume.

The user enters data in the UI step by step in response to questions from the computer; the choice of question the computer asks at a given point is influenced by preceding responses from the user. Also, at many intermediate points, the computer processes the set of answers given to that point and displays the results to guide further decisionmaking or to allow the user to recycle through the process if he is dissatisfied with the results at that point. In this way the UI produces a course description that interrelates course content, teaching strategy, student characteristics, and resource assignments.

MODIA inputs UI data automatically to the RUM, which simulates the way student progression through the course generates requirements for training resources. The RUM receives all of its inputs in a single batch and produces all of its outputs in a single batch. The outputs are detailed reports on course operation, including student flow patterns and waiting times as well as resource demand and use.

Planners will rarely be satisfied with the results of the first complete operation of the UI and RUM and will repeat the process several times before they prepare the input required for MODCOM. They may, however, use MODCOM early in the design process to compare rough, order-of-magnitude cost estimates to help select among preliminary course designs.

MODCOM estimates the five-year investment and operating cost associated with a given course design. Its inputs are provided in a single batch by the planner,

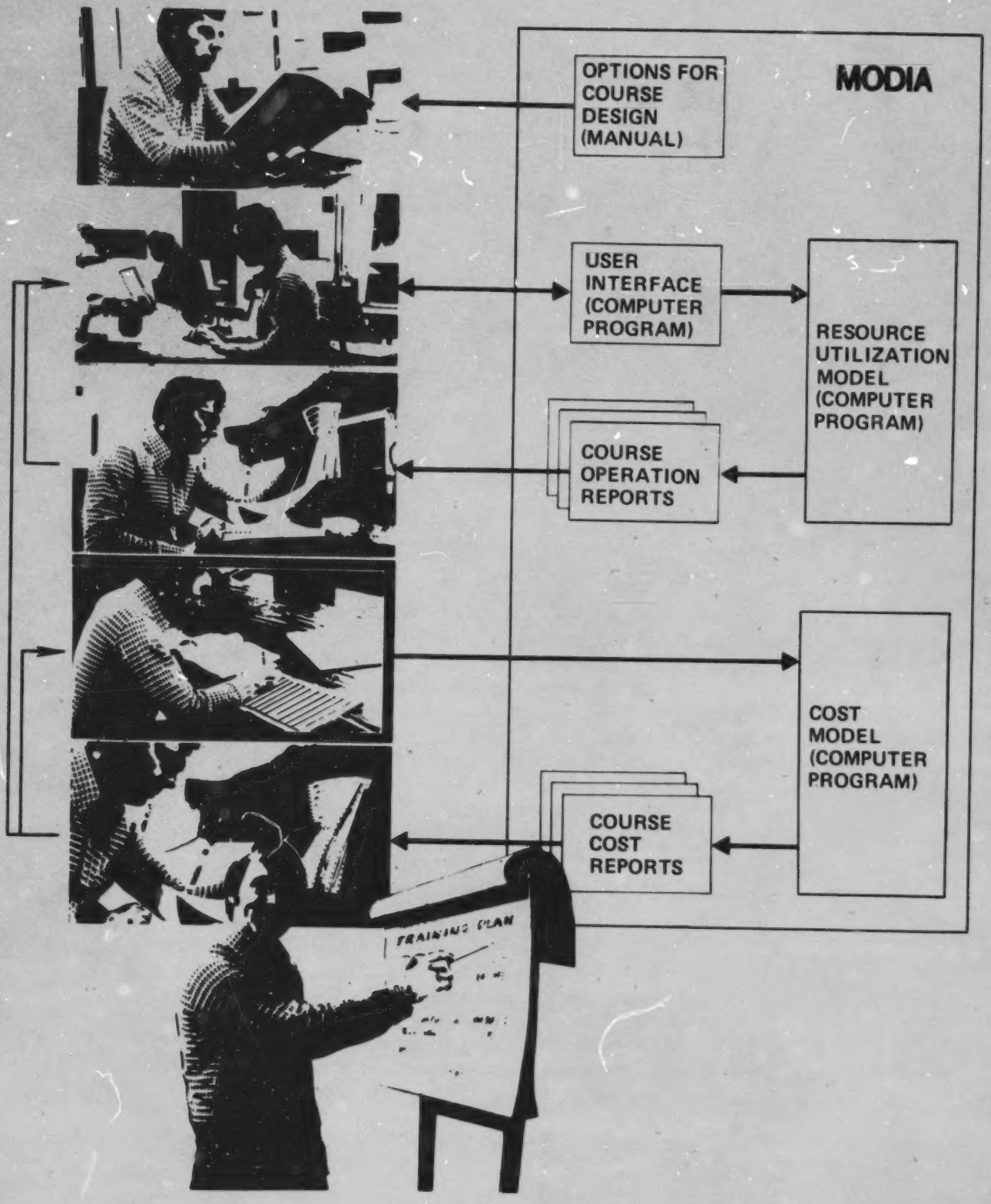

Fig. 1—Interactions between the user and MODIA components

who can take some inputs, such as resource requirements, from RUM and UI output, but must draw on other sources for such items as equipment costs.

Since MODCOM requires some input that is not a direct consequence of RUM output, planners may wish to exercise MODCOM several times without revising the initial input to the UI. However, the cost reports may highlight a feature of course operation that is unwarrantedly expensive, indicating additional operation of the UI and RUM. Since subsequent passes rarely entail complete redesign of the course, they often take only a small fraction of the time and attention required for creation of the first case.

When the planners are satisfied with both the course operation and course cost reports for a specific course design, they have at hand the bulk of the elements for a training plan and need only synchronize the plan with other planning activities at the school to put it in final form.

PERSONNEL

Two groups of people should be involved in any application of MODIA in planning—those who are expert in using MODIA ("the MODIA team") and those who have knowledge and experience in the areas of subject matter and planning particular to the course being developed (the "subject matter experts"). Figure 2 shows the configuration currently being used at the Keesler Technical School.

Members of the MODIA team need not have extensive experience with computers. By background and bent they should be problem solvers first, computer experts second. They need to be familiar with course planning and school operations, however, so that they can draw out the subject matter experts' best judgment on what constitutes effective instruction and help distinguish between what is usually done (for convenience or by tradition) and what is needed. They should also have a feeling for how far school policies can be adjusted and if it would be desirable to do so, and they should be able to act as liaison among different organizational entities within the school whose interests may clash within a given training course design.

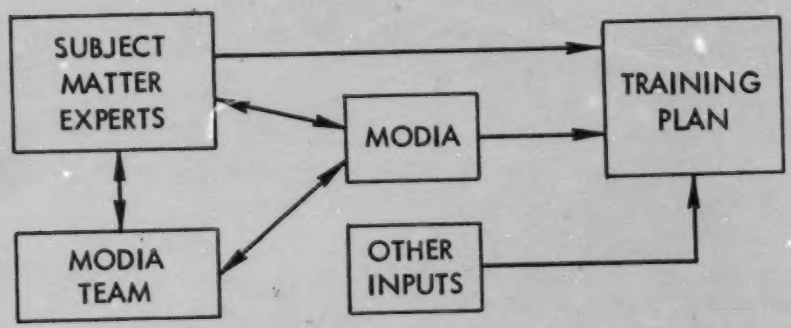

Fig. 2—Configuration currently in use at Keesler Technical School

The MODIA team needs initial training in the use of the system and needs to apply the system frequently enough to maintain their expertise. They should be fully aware of MODIA's features and operation, particularly of the alternatives it encompasses, they should have a good feel for the effects of different choices of input on MODIA outputs, and they should be able to guide the subject matter experts in choosing the most efficient alternatives. Members of the MODIA team will be the primary users of this report.

The subject matter experts are people who normally plan and develop courses. They need an understanding not only of the subject of the course but of the student population and the teaching methods that work best for them. They should be familiar with school policy and should know what resources are likely to be available to the course and what those resources will cost. All of this information need not reside in a single person (nor does it in the current development process). Perhaps most important, the subject matter experts need to be flexible—able to interact with the MODIA team so that the special abilities of both groups can be fully applied.

PLAN OF THE REPORT

This report, describing the operation and design of the User Interface, serves two different types of readers—those who will use the UI to plan a course, and systems analysts and programmers who are responsible for the acquisition, maintenance, and extension of the MODIA system at their own site. To accommodate both, the next section describes the purpose of the UI and factors affecting its design. Section III tells planners how to operate the UI program. The appendix, which describes the program's internal operation, is presented as a separate volume for the system analyst and programmer. Words and phrases that have technical meanings within MODIA are defined in the glossary.

THE CODE CARD

In a pocket at the back of this report is a card for quick reference at the terminal. After a question, the UI usually displays a set of codes for the answers that may be chosen. The code card contains a brief translation of each code along with a reference to the section of the *Options* volume where the code is discussed. The glossary is also reproduced on the code card.

II. PURPOSE AND CHARACTERISTICS OF THE USER INTERFACE

MODIA has been designed to be an assistant to planners, helping them consider many alternative course designs in the process of planning a course. MODIA performs those tasks that are performed well by a computer—to organize, to verify, to simulate, and to calculate; people are needed to perform those tasks that are done poorly by a computer—to conceive, to design, and to evaluate. To show how MODIA and planners work together, we describe what each does to produce a course plan.

Course planning involves three processes—synthesis, analysis, and evaluation. Given a need and the objectives for a particular course, we may first synthesize a design for that course, then analyze that design to determine its cost and operating characteristics, and finally evaluate the design against some desired goal or against other, alternative designs. Figure 3 shows the relation of MODIA's components to these steps. Of course, the figure is highly simplified, as many feedback paths among and within the boxes are not shown. As is shown, MODIA assists planners in both the synthesis and analysis tasks. The planner performs the evaluation.

Planners play a key role in the synthesis of alternative designs. They may be trying, for example, to attain certain educational objectives within the constraints of school policy, the resources at hand, budget available to buy new resources, types and kinds of instructors available, and types and numbers of students expected. They must combine these requirements with their knowledge of the subject matter, some educational psychology, and some common sense to arrive at a design for the course. Within these constraints, they have considerable freedom to design the course they believe will best attain the course objectives. For example, they can determine the format and sequence of material to be presented, the media for presenting the material, and which students will receive what material. Such a design process is largely inductive, subjective, and innovative—qualities seldom associated with computers.

The translation of the planners' insights and policy decisions into a comprehensive, complete, and internally consistent course design is a time-consuming task. The UI relieves planners of these functions to allow them to concentrate on the more subtle, complex problems of educational policy for the course. Furthermore, the UI recasts the course description for input to the RUM, a task so demanding, if done manually, that it would rarely be undertaken. The RUM produces reports on course operation and resource requirements or use, a key step in the analysis of the course design.

The seven steps shown in Fig. 4 appear to be a natural way to go about synthesizing a course design. The description of training objectives, the description of the student population, and the general policy for course diversification may proceed in parallel; but these must be completed before the policy for teaching each objective (teaching policy) may be defined. When the teaching policy is complete, the objectives may be expanded into learning events representing the overall course design, and details of major tests may be specified. At this point, the resources for the course may be assigned to learning events that use them; next, the constraints

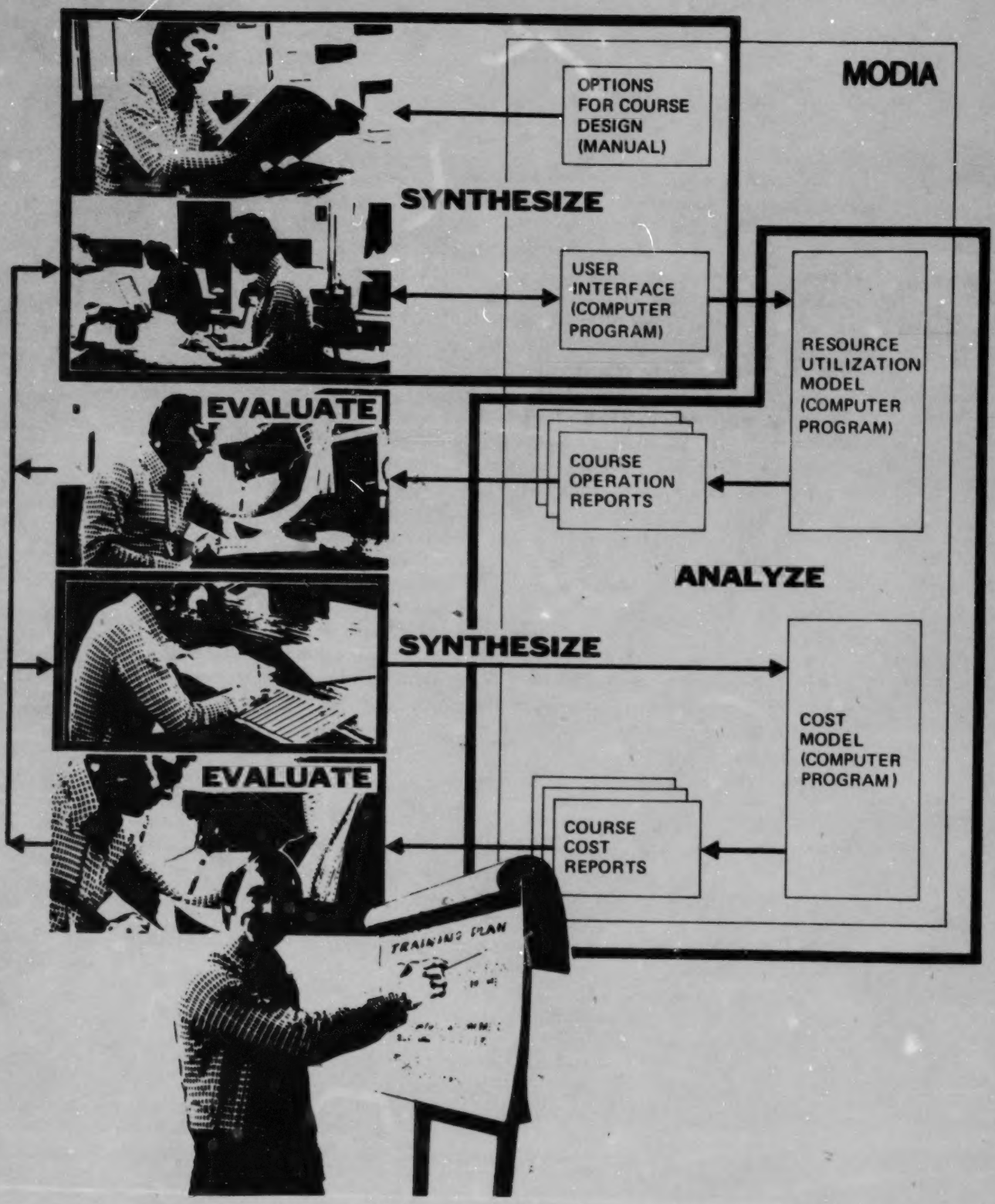

Fig. 3—Relation of MODIA components to steps in planning

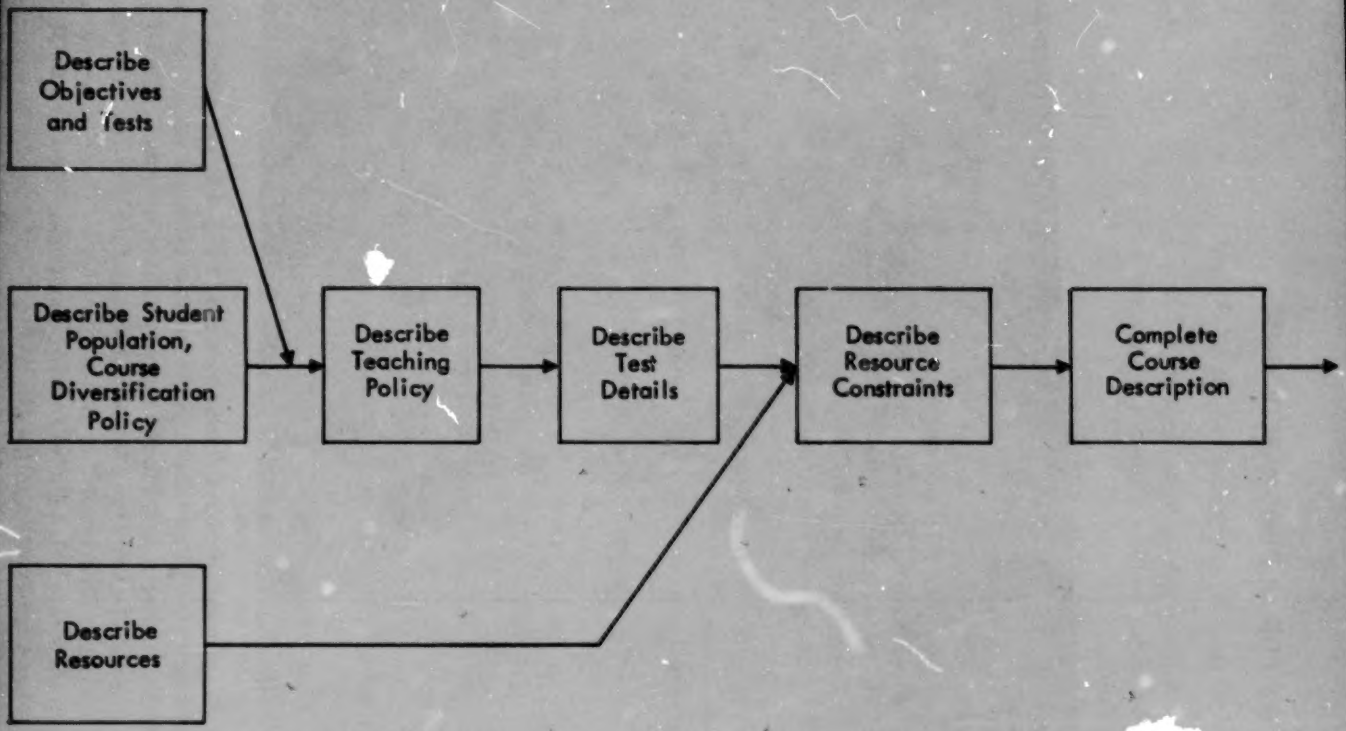

Fig. 4—Synthesize the course design

on the use of resources may be specified. Design synthesis is completed by specification of section size and average time for each learning event.

GUIDELINES FOR UI PROGRAM DESIGN

Six general considerations directed the UI design:

a. The course planning environment.
b. Relationship to natural steps in synthesis.
c. Iteration.
d. Keyboard/typewriter interface.
e. Facilitation of access to the program.
f. References to the *Options for Course Design.*

First, technical courses are designed by a committee of subject matter experts drawn from the various management centers in the school responsible for the course. Over a period of a few weeks to several months, the committee generates a rough course design and presents it to the school's management for approval. Once the plan has been approved, the course represented by the plan is developed, often by course instructors. Individual courses are significantly revised quite infrequently, say once a year at most. Therefore, experts in the subjects pertaining to them will only occasionally interact with MODIA and the MODIA team described previously. Members of this team provide an interface between MODIA and the subject matter experts and use MODIA frequently enough to maintain their expertise.

The MODIA team and the subject matter experts design the course in concert; the subject matter experts must understand what is going on well enough to know whether their specifications are being met and to feel comfortable with the design process. Therefore, the program provides a reasonably complete explanation of each action or request at the expense of the additional time required. Although the user may bypass several displays of tabular information once he has become familiar with the system, there is no "terse" mode of operation that would reduce questions to a one- or two-word cue and thereby reduce the time spent waiting for a question to be displayed. This may be annoying to frequent users, but the "verbose" mode of operation is more appropriate for subject matter experts. However, the complexity of inputs has been minimized by asking for yes/no answers or other codified responses where possible and allowing the assignment of arbitrary names to entities the planner defines.

Second, the program design follows the steps in Fig. 4 to the extent possible, because these lead the planner through the various planning stages in a natural sequence from the more general to the more specific in definition. The UI follows the steps in Fig. 4 in the sequence of operations shown in Fig 5. The last step in Fig. 4, "Complete Course Description," is incorporated with "Describe Resource Constraints" in Fig. 5, which also includes an additional phase, "Describe RUM Parameters," to control the operation of the RUM.

These steps must be performed in sequence. Once a decision has been entered into the UI it generally cannot be changed except by using the iteration capability described below. Although this limitation is inconvenient (especially when only a

minor modification to an existing course design is desired), it requires considerably less training than would the extensive language or complicated input format if the limitation were removed. In addition, the sequential structure ensures that the course design is internally consistent because it re-executes the decision logic on the basis of the new answers to each question, bypassing questions that are not relevant because of answers to earlier questions.

The sequential nature of the design process allows planners to build the design step by step. To capitalize on this feature, the program produces displays of the course design in intermediate stages. These displays are printed on paper so that planners may study them at length before progressing to the next step. They may also be used as worksheets to prepare for later design stages, as discussed throughout the report. This feature makes full use of planners' cognitive and evaluation powers in course design. (It also eliminates the use of transient displays such as those of cathode ray tubes or TV screens.)

Third, the UI allows a limited amount of iteration within the program to refine a course design by retaining decisions and inputs of each major phase for use by subsequent phases and for reuse on subsequent runs of the program. This permits the user to go back to the beginning of any phase; from that point, the UI requires subsequent decisions to be respecified. In addition, at several points within phases the UI provides the user with opportunities to override earlier decisions.

Fourth, so that the keyboard/typewriter interface can be used on a large number of computer systems, it is limited to a width of 72 characters, with continuous form and no provision for special formatting. This makes the interface a bit clumsy for the planner, especially when very complex information describing intermediate and final stages in the course design must be displayed. The keyboard/typewriter interface also limits the collection of information from the planner to the entry of keyboard characters in response to computer-generated questions.

Fifth, the UI has some special functions to make it easier to use. In particular, the user may stop the system operation at any time by answering "Q" (for quit) in response to any question. He may have the standard MODIA codes displayed just before the first use by answering "Y" (for yes) in response to a question regarding the display of the system codes. (These codes are also available on the code card described previously.) The UI normally prompts the user with a list of the expected and appropriate answers when such a list is predetermined.

Finally, the UI frequently refers to sections of the companion report, *Options for Course Design*. This allows planners to locate material that presents guidance for responding to the questions that follow each reference.

III. OPERATING THE USER INTERFACE

GENERAL INSTRUCTIONS

The following instructions apply to operation of all phases of the UI program.

Starting a Session

Procedures for obtaining access to the UI program through the terminal are unique to each installation; they should be obtained through consultation with the operators on site.

Entering Answers

Once the user has obtained access to the UI program, the program requests answers to a series of questions. To enter an answer, the user types his response and then depresses the carriage return to signify the completion of the entry. The computer will not read the answer unless the carriage return is depressed.

The program requests responses in three forms: a code from among a set of codes that are acceptable at that point (e.g., Y or N for Yes or No), a number, or an entry the user designates.

In the first case, acceptable codes are displayed automatically if the list is short. The user can have longer lists, along with their meanings, displayed at the beginning of the interaction; this information is also on the code card. If an answer not among the codes is entered, the program responds, "Error in entry. Please re-enter," until an acceptable code has been entered.

If a number is called for, the answer must be an integer (including zero in some instances) except in two cases, described later. If the user enters a non-integer answer to a question calling for a number, the program responds, "Non-numeric[1] characters entered, please re-enter," and repeats the question.

In the last instance, the user may enter any combination of eight characters or less that he desires. There is one exception—the blank space, which the UI interprets as the end of an entry. Therefore, the UI will not accept as a single entry one in which there is a blank space.

The user may enter more than eight characters if he desires, but the program will read only the first eight. Thus, entries of "INSTRUCTOR1" and "INSTRUCTOR2" will both be read as "INSTRUCT" by the program.

Entering a List

Sometimes the UI asks the user to enter a list of answers. In this case, a question mark (?) appears at the beginning of each line on which a new entry in the list may be made. To terminate the list, the user need only respond to the last ? with a carriage return.

[1] This should read "non-integer" to be precise.

Correcting Mistakes

Different computer systems have different procedures (such as backspacing and retyping) for revising an entry *before* the carriage return is depressed. Once the carriage return has been depressed, however, correcting mistakes is more difficult. Although the UI allows modification of some keyboard entries at a later point in its operation, it frequently requires a complete rerun through the phase in which the mistake has been made. (We discuss other provisions for correcting mistakes in the detailed description of program operation below.) Therefore, we strongly advise the user to check each answer *before* depressing the carriage return and to modify erroneous entries using the procedure appropriate to the computer system.

Stopping the Program

As mentioned earlier, the UI can be stopped in any phase by the entry of "Q" (for "Quit") in response to any question. This entry stops the operation of the program entirely; to reinitiate operation, the user must start a new computer job. The UI cannot be stopped between phases (discussed further below) because at that point the user cannot communicate with the program. To stop at the completion of a phase, enter "Q" in response to the first question asked in the *next* phase.

The Program Phases

The UI has eight sequential phases:

1. Select the Planning Phase.
2. Describe Objectives and Tests.
3. Describe Student Population and Course Diversification.
4. Describe Teaching Policy.
5. Describe Test Details.
6. Describe Resources.
7. Describe Resource Constraints (and Finish Course Description).
8. Describe RUM Parameters.

The first phase permits the user to choose one of the other phases as a starting point for the design session. The next six phases constitute the process of course design shown on Fig. 4. The final phase controls the operation of the RUM.

At the completion of each phase, the program collates the entries made during that phase into a form that can be used by later phases. If the program is stopped before the phase is complete, the collation does not take place, and all of the entries made in that phase are lost. Entries made in earlier phases are retained, however. This is why the user should "Quit" at the first part of a new phase, rather than at the last part of the just completed phase, to stop a session between phases.

SELECT THE PLANNING PHASE—PHASE 1

Figure 5 shows the presentation the program makes to the user in the first phase. If the session is the first one the user has participated in, there will be no

```
WELCOME TO MODIA.

YOU MAY START YOUR SESSION AT ANY
OF THE FOLLOWING SEQUENTIAL PHASES
(UNLESS THIS IS THE FIRST DESIGN PASS)-
CODE     PHASE
----     -----
 I       DESCRIBE OBJECTIVES AND TESTS
            (INITIALIZE DESIGN)
 S       DESCRIBE STUDENT POPULATION
            AND COURSE DIVERSIFICATION
 P       DESCRIBE TEACHING POLICY
 T       DESCRIBE TEST DETAILS
 R       DESCRIBE RESOURCES
 C       DESCRIBE RESOURCE CONSTRAINTS
RUM      DESCRIBE RUM PARAMETERS
WHICH PHASE ? I
```

Fig. 5—Select the planning phase

information stored in the computer from any of the phases and the program will not have anything to work on. Therefore, for the first session, the user must start at the second phase, *Describe Objectives and Tests*, or the program will not operate.

If the user enters an acceptable code other than "I," the UI bypasses the phases before the one the user selects and uses the data last entered in the bypassed phases in previous design sessions as a basis for continuing the course design. This process is the major mechanism for iteration of course design, because it permits the user to modify many features of the design without having to go all the way back to the beginning of the design process.

DESCRIBE OBJECTIVES AND TESTS—PHASE 2

Overview

In this phase the user lists the objectives to be taught and identifies the placement of major tests and the training activities related to them. After listing the objectives, the user assigns subject matter types to them and to the tests and reviews. The UI produces two intermediate reports to help the user during this phase—the first and second expansions of training objectives. Figure 6 illustrates the sequence of decisions made in this phase. Note that the UI refers to sections of the *Options* volume that discuss the rationale for making various entries and to worksheets included in the *Options* volume, on which the user may have recorded preliminary choices.

Discussion

First the user lists the course objectives in the sequence in which they will be taught by entering a brief mnemonic code for each. Objectives cannot be added or resequenced without going back to the beginning of Phase 2.[8]

[8] An objective can, in effect, be deleted by assigning no resources and zero time to it in later phases.

```
THROUGHOUT THE USER INTERFACE PROGRAM, ALL NUMBERS
ENTERED SHOULD BE INTEGERS EXCEPT FOR RATES OF PROGRESS
**********************************************************
****  TRAINING OBJECTIVES  ****
PLEASE NAME THE OBJECTIVES IN THE SEQUENCE IN WHICH THEY WILL BE TAUGHT
REFER TO II A (CHOOSING OBJECTIVES), II B (SEQUENCING),
 WORKSHEET I, TABLE A
?  TESTEQP
?  URN5CHAR
?  SERVROUT
?  URN5CHAR
?  SERVROUT
?  TBSHPRIN
?  TBSHURN5
?  FLTCHK
?  INSTALL
?
DO YOU WANT TO SEE THE CODES FOR THE SUBJECT MATTER TYPES (Y/N)?  Y

TYPE     SUBJECT MATTER TYPE                                  REFER TO II C
  1       EASY FACTS AND CONCEPTS                                      1
  2       DIFFICULT FACTS AND CONCEPTS                                 1
  3       SIMPLE CLASSROOM SKILLS (SELECTED RESPONSE)            2, 2A
  4       SIMPLE CLASSROOM SKILLS (CONSTRUCTED RESPONSE)         2, 2A
  5       COMPLEX CLASSROOM SKILLS (SELECTED RESPONSE)           2, 2B
  6       COMPLEX CLASSROOM SKILLS (CONSTRUCTED RESPONSE)        2, 2B
  7       TEAM SKILL WITH SPECIAL RESOURCES                            3
  8       INDIV SKILL WITH SPECIAL RESOURCES (PRODUCT ONLY)      4, 4A
  9       INDIV SKILL WITH SPECIAL RESOURCES (PROCESS ONLY)      4, 4B
  10      INDIV SKILL WITH SPECIAL RESOURCES (PROD. AND PROC.)   4, 4C
PLEASE ENTER SUBJECT MATTER TYPES FOR EACH OBJECTIVE YOU LISTED ABOVE
IN THE SEQUENCE IN WHICH THEY WILL BE TAUGHT
REFER TO II C, WORKSHEET I, TABLE B
TESTEQP.
?  1
?  2
?
URN5CHAR
?  2
?  6
?
SERVROUT
?  7
?
URN5CHAR
?  6
?
SERVROUT
?  7
?
TBSHPRIN
?  1
?  2
?
TBSHURN5
?  7
?
FLTCHK..
?  1
?
INSTALL.
?  1
?
```

Fig. 6—Describe objectives and tests

```
**************************************************
****  FIRST EXPANSION OF TRAINING OBJECTIVES  ****
SEQ      NAME      SUBJ. MATTER
 1       TESTEQP.        1
 2       TESTEQP.        2
 3       URN5CHAR        2
 4       URN5CHAR        6
 5       SERVROUT        7
 6       URN5CHAR        6
 7       SERVROUT        7
 8       TBSHPRIN        1
 9       TBSHPRIN        2
 10      TBSHURN5        7
 11      FLTCHK..        1
 12      INSTALL.        1

FOR NEXT QUESTIONS REFER TO III, III A, B, C
WILL THERE BE EXAMS IN THIS COURSE (Y/N)?  Y
******************
****  EXAMS  ****
FOR NEXT QUESTIONS REFER TO III D
IS IT POSSIBLE THAT STUDENTS WILL FAIL THE COURSE? (Y/N)?  Y
WHAT PERCENT OF FAILURES DO YOU EXPECT IN THE COURSE ? 15
FOR NEXT QUESTIONS REFER TO III E
IS IT POSSIBLE THAT STUDENTS WILL RECYCLE PORTIONS OF THE COURSE? Y
WHAT IS THE MAXIMUM NUMBER OF RECYCLES YOU WILL PERMIT? 2
FOR NEXT QUESTIONS REFER TO III G
WILL THERE BE REVIEWS BEFORE EXAMS (Y/N)?  Y
WILL THERE BE CRITIQUES AFTER EXAMS (Y/N)?  Y
PLEASE ENTER THE NUMBER OF THE LAST OBJECTIVE BEFORE EACH EXAM FROM THE
FIRST EXPANSION OF TRAINING OBJECTIVES (IN SEQUENCE)   (WORKSHEET II)
EXAM1 ? 12
EXAM2 ?
FOR ASSIGNING SUBJECT MATTER TYPES REFER TO III H
--------EXAM1   AFTER SEQUENCE NUMBER 12 --------
PLEASE ENTER SUBJECT MATTER TYPES FOR EXAM1
?  6
?  7
?
WILL THERE BE A REVIEW (Y/N)?  Y
PLEASE ENTER SUBJECT MATTER TYPES FOR REVUE.1
?  6
?
WILL THERE BE A CRITIQUE (Y/N)?  Y
**************************************************************************
**** SECOND EXPANSION OF TRAINING OBJECTIVES (INCLUDING TESTS) ****
          OBJECTIVE      SUBJECT
SEQ       NAME           MATTER
--------------------------------
1         TESTEQP.         1
2         TESTEQP.         2
3         URN5CHAR         2
4         URN5CHAR         6
5         SERVROUT         7
6         URN5CHAR         6
7         SERVROUT         7
8         TBSHPRIN         1
9         TBSHPRIN         2
10        TBSHURN5         7
11        FLTCHK..         1
12        INSTALL.         1
13        REVUE1..         6
14        EXAM1...         6
15        EXAM1...         7
16        CRITQ1..         1
```

Fig. 6—Continued

The UI interprets each separate entry as a separate objective regardless of the code entered. This allows the use of the same code for different phases of training pertaining to the same topic, if desired. Note that this feature has been used in Fig. 6.

Next, as the UI displays each objective in turn, the user enters a list of subject matter types appropriate for teaching the objective. The sequence in which the subject matter types are entered determines the sequence in which each related training activity will take place. Any sequence may be used, and the same subject matter number may be entered for a single objective as often as desired.

After entry is complete, the UI automatically assigns a sequence of numbers, one to each combination of objective and subject matter type, and displays this list as the "First Expansion of Training Objectives."

If the user indicates that tests will be included in the course plan, the UI asks whether there will be failures, recycles, reviews, or critiques. If there are failures, the UI asks for the total course failure rate; if recycles, it asks for the maximum number of recycles.

The UI then collects the points at which tests will be given by asking for the sequence number from the "First Expansion of Training Objectives" of the combination of objective and subject matter type immediately preceding each test. More than one test may be entered at the same point. This should be done only if a student may be eliminated from the course or recycled before he completes all parts of a multi-part test. After the list of tests has been entered in the UI, the program asks for the following information for each test in turn:

- The subject matter types for the test.
- Whether the test will be preceded by a review in scheduled instruction for at least one category of student,[3] if the user has indicated that there will be reviews in the course.
- The subject matter types for the review, if there will be a review before the test.
- Whether there will be a critique after the test in scheduled instruction for at least one category of student, if the user has indicated that there will be critiques in the course.

Subject matter types are not assigned to critiques because the UI automatically treats them as type 1 subject matter.

The UI then automatically sequences and numbers the combinations of objectives and subject matter types, reviews and subject matter types, tests and subject matter types, and critiques and presents the result as the "Second Expansion of Training Objectives (including Tests)" as shown on p. 3 of Fig. 6. The total number of entries in this list may be no more than 250. In fact, the total number of learning events (produced in Phase 4) that may be entered in the UI is 250. Therefore, if the user plans to assign more than one learning event type for teaching a particular subject matter type, he should not use up all 250 entries in this phase.

On completion of this phase, the user may want to save the "Second Expansion of Training Objectives," which can serve as a worksheet to guide content diversification if desired. This use is illustrated later.

[3] Reviews and critiques given outside of regular class hours should be designated as homework events in Phase 4, *Describe Teaching Policy*.

DESCRIBE STUDENT POPULATION AND COURSE DIVERSIFICATION—PHASE 3

Overview

The steps in this phase are illustrated in Fig. 7. First the user describes how students arrive at the course; next, he establishes whether the course is "diversified" and, if so, what forms of diversification are used and how students are categorized for diversification.

```
**********************************
**** STUDENT POPULATION ****
FOR NEXT QUESTIONS REFER TO V A, WORKSHEET III, TABLE A
DO STUDENTS ARRIVE AT FIXED INTERVALS (Y/N)? Y
DO STUDENTS ARRIVE IN GROUPS OF FIXED SIZE (Y/N)? Y
WHAT IS THE TIME BETWEEN ARRIVALS (HRS)? 30
WHAT IS THE GROUP SIZE? 16
FOR NEXT QUESTIONS REFER TO V B, V B 1, 2, 3
WILL THE COURSE BE TAUGHT DIFFERENTLY TO DIFFERENT STUDENTS BY VARYING
CONTENT AND/OR METHOD (Y/N)? Y
WILL TPACKING BE USED (Y/N)? Y
WILL THE CONTENT BE DIFFERENT FOR DIFFERENT STUDENTS (Y/N)? Y
PICK ONE OF THE FOLLOWING AS A BASIS FOR CATEGORIZING STUDENTS
REFER TO V C, WORKSHEET III, TABLE B
1  ABILITY ONLY
2  OTHER CHARACTERISTIC ONLY
3  BOTH ABILITY AND OTHER CHARACTERISTIC
WHICH? 3
PLEASE NAME THE OTHER CHARACTERISTIC? E.E.TNG
WHAT PERCENT OF THE ENTERING STUDENTS ARE E.E.TNG ? 30
WHAT PERCENT OF THE ENTERING STUDENTS ARE SLOW? 40
**********************************************

**** DESCRIPTION OF STUDENT CATEGORIES ****
CATEGORY  STUDENT          PERCENT
ID        CATEGORY         TOTAL
1       SLOW NON-E.E.TNG.  28
2       SLOW E.E.TNG.      12
3       FAST NON-E.E.TNG.  42
4       FAST E.E.TNG.      18
```

Fig. 7—Describe student population and course diversification

Discussion

Four options are available for describing student entries. These are selected by the user's YES/NO response to questions on fixed entry interval and fixed group size, as shown below.

OPTIONS FOR SPECIFYING STUDENT ARRIVALS

	1	2	3	4
Fixed entry interval?	Yes	No	Yes	No
Fixed entry group size?	Yes	No	No	Yes

Figure 7, showing a YES response to both questions, illustrates Option 1. To complete the description of Option 1, the user needs only to specify the length of the entry interval (time between arrivals, in hours, of groups of students new to the course) and the size of the entry group. To describe Option 2, the user specifies the average length of the entry interval and the average size of the group. For Option 3, the user specifies the size of the entry group, the average length of the entry interval, and the *spread* in length of the interval (difference between the maximum or minimum length and the average). Similarly, for Option 4, the user specifies the average size of the entry group, the spread in entry group size, and the length of the entry interval.

If more than one shift[4] will be operating for the course, enter data for only one shift. The MODCOM documentation describes how additional shifts are accounted for.[5]

Next, the user indicates whether the course will be taught differently to different students by varying content or method. If the answer to this question is "No," the phase is complete. If the answer is "Yes," the user next indicates whether students will be separated into tracks. If two or more tracks of students will be taught on the same shift, tracking should be indicated. Simulation of the case where each track is taught on a different shift requires separate runs of the RUM, and the tracking question should be answered "No."

If tracking will be used, the user next tells the UI whether course content will be different for different students, as shown in Fig. 7. If tracking will not be used, the user tells the UI whether the teaching method will be different for different students before he answers the question on content.[6]

Whatever form of diversification is selected, the user next chooses a basis for categorizing students—ability, some other characteristic, or both ability and another characteristic. If he selects ability, he may establish the following categories of students:

No of Categories	Designation
2	Slow, Fast
3	Slow, Average, Fast
4	Slow, Slower than Average, Faster than Average, Fast

[4] A shift is a period of time during the day—e.g., 0600–1200, 1200–1800, 1800–2400. The foregoing are the shifts most often used in ATC.

[5] Ronald Hess and Phyllis Kantar, *MODIA: Vol. 5, User's Guide to The Cost Model*, R-1704-AF.

[6] In Phase 5, *Describe Test Details*, different rates of failure may be specified for different categories of students if student categories have been established. This may be done without actually diversifying the course plan, as follows: (1) Answer "Yes" to the question about whether the course will be taught differently to different students by varying content or method. (2) Answer "No" to tracking and "No" to differentiation of teaching method. (3) Answer "Yes" to differentiation of content. (4) Answer "No" to differentiation of content for each category of students when it is asked in Phase 4, *Describe Teaching Policy*.

If he selects another characteristic, he may establish only two categories of students—those with the characteristic and those without it. If he selects both ability and another characteristic, he must establish four categories of students—slow students with the characteristic, slow students without the characteristic, fast students with the characteristic, and fast students without the characteristic. If the user chooses either of the options with another characteristic than ability, he assigns a name to the characteristic, as shown in Fig. 7.

The UI next asks the user to estimate the percent of entering students that have the characteristics chosen for categorization. To eliminate the possibility that the percentages entered will not total 100, the UI asks for only enough entries to allow the program to compute those remaining. For example, if the students are categorized only as Slow and Fast, the UI asks only for the percent of students who are Slow and then displays the percentages assigned to both categories along with identification numbers to which the user refers in the next phase. To specify the percentage of students in each of the four categories established in Fig. 7, the user indicates the percent that have the chosen characteristic and the percent at the slower ability level. The UI computes the required breakdown into the four groups from these data and displays the results along with identifiers as shown in the figure.[7] These identifiers, in the column marked by an arrow, must be used in the next phase.

This completes the third phase. The user should save all of the printed record of interaction with this phase for later use.

DESCRIBE TEACHING POLICY—PHASE 4

Overview

In this phase four major steps are taken: Student categories are allocated to tracks or groups (if tracking has been chosen or teaching method is diversified without tracking), content skipped by each student category is specified (if content is diversified), the method for teaching each type of subject matter in the course is defined, and the UI expands the result into a "Final List of Learning Events" that displays the detailed structure of the course. (Recall that the function of the subject matter types is to permit the user to define teaching method for all objectives with a given subject matter type at once rather than having to define teaching method objective by objective, as discussed in *Options for Course Design*, Sec. II.C.)

Discussion

First the UI asks the user to enter the length of one training shift in minutes and the average daily homework required in minutes. The program uses these numbers later to compute the number of classroom days and homework sessions in the course.

Next, if tracking has been chosen, as shown for our example in Fig. 8, the user specifies how the tracks will be constituted, the number of tracks (always between

[7] The computation assumes the same proportions of slower and faster students in categories that do and do not have the characteristics.

```
**************************************
**** LENGTH OF THE TRAINING DAY ****
PLEASE ENTER THE LENGTH OF ONE TRAINING SHIFT IN MINUTES ? 360
PLEASE ENTER THE AVERAGE DAILY HOMEWORK REQUIRED IN MINUTES ? 60
**************************
**** TRACKING POLICY ****
FOR NEXT QUESTIONS REFER TO VI B 1, WORKSHEET IV, TABLE A
HOW MANY TRACKS ARE IN THE COURSE (2, 3, OR 4)?  3
PLEASE USE THE CATEGORY ID FROM THE DESCRIPTION OF STUDENT CATEGORIES
ABOVE TO ANSWER THE NEXT FEW QUESTIONS
WHICH STUDENT CATEGORIES ARE IN TRACK   1
?  1
?
WHICH STUDENT CATEGORIES ARE IN TRACK   2
?  3
?
WHICH STUDENT CATEGORIES ARE IN TRACK   3
?  2
?  4
?
**************************************
**** SUMMARY OF TRACKING DECISIONS ****
TRACK              STUDENT
ID                 CATEGORY
1                  SLOW NON-E.E.TNG.
2                  FAST NON-E.E.TNG.
3                  SLOW E.E.TNG.
                   FAST E.E.TNG.
ARE YOU SATISFIED WITH THIS TRACKING POLICY (Y/N)? Y

**********************************
**** CONTENT DIVERSIFICATION ****
FOR NEXT QUESTIONS REFER TO VI B 1, WORKSHEET IV,T ABLE B
WILL SLOW NON-E.E.TNG. SKIP ANY CONTENT (Y/N)?  N
WILL SLOW E.E.TNG. SKIP ANY CONTENT (Y/N)?  Y
USING THE SECOND EXPANSION OF TRAINING OBJECTIVES ABOVE,
PLEASE ENTER THE SEQUENCE NUMBERS TO BE SKIPPED
?  1
?
WILL FAST NON-E.E.TNG. SKIP ANY CONTENT (Y/N)?  Y
USING THE SECOND EXPANSION OF TRAINING OBJECTIVES ABOVE,
PLEASE ENTER THE SEQUENCE NUMBERS TO BE SKIPPED
?  13
?
WILL FAST E.E.TNG. SKIP ANY CONTENT (Y/N)?  Y
USING THE SECOND EXPANSION OF TRAINING OBJECTIVES ABOVE,
PLEASE ENTER THE SEQUENCE NUMBERS TO BE SKIPPED
?  1
?  2
?  13
?
```

Fig. 8—Describe teaching policy (tracking) (page 1 of 6)

```
**********************************************************
**** SUMMARY OF CONTENT DIVERSIFICATION AND OBJECTIVES ****
      OBJECTIVES                STUDENT CATEGORY
     ---------------   ----------------------------------------
SEQ  NAME     SUBJECT  SLOW       SLOW          FAST       FAST
NUM           MATTER   NON-E.E.TNE.E.TNG.      NON-E.E.TNE.E.TNG.
1    TESTEQP. 1        X                        X
2    TESTEQP. 2        X          X             X
3    URN5CHAR 2        X          X             X          X
4    URN5CHAR 6        X          X             X          X
5    SERVROUT 7        X          X             X          X
6    URN5CHAR 6        X          X             X          X
7    SERVROUT 7        X          X             X          X
8    TBSHPRIN 1        X          X             X          X
9    TBSHPRIN 2        X          X             X          X
10   TBSHURN5 7        X          X             X          X
11   FLTCHK.. 1        X          X             X          X
12   INSTALL. 1        X          X             X          X
13   REVUE1.. 6        X          X
14   EXAM1... 6        X          X             X          X
15   EXAM1... 7        X          X             X          X
16   CRITQ1.. 1        X          X             X          X
WOULD YOU LIKE TO SEE THE CODES FOR SPECIFYING TEACHING METHOD (Y/N)? Y
**********************************
**** LEARNING EVENT CODES ****
CODE              TYPE OF LEARNING EVENT    REFER TO SUBSECTIONS OF VI D 1
----              ----------------------
P                 PRESENTATION
GP                GUIDED PRACTICE
UP                UNGUIDED PRACTICE
D                 DISCUSSION
CP                CHECK PRACTICE
HW                HOMEWORK
R                 REVIEW
T                 TEST
C                 CRITIQUE
**********************************
**** TEACHING FORMAT CODES ****
CODE              TYPE OF TEACHING FORMAT   REFER TO VI D 2
----              -----------------------
AF                ADAPTIVE                       G
RF                RESPONSE-PACED                 F
R                 RECITATION                     E
S                 SIMPLE                         D
G                 GROUP INTERACTION              C
**********************************
**** TEACHING AGENT CODES ****
CODE              TYPE OF TEACHING AGENT    REFER TO VI D 3, VI D 3F
----              ----------------------
AP                ADAPTIVE
RP                RESPONSE-PACED
I                 INSTRUCTOR
L                 LEARNER
```

Fig. 8—Continued (page 2 of 6)

```
**********************************
**** TEACHING METHOD POLICY ****
THE FOLLOWING SECTION WILL REFER FREQUENTLY TO THE SUBJECT MATTER
TYPE CODES AND THE TEACHING METHOD CODES (REFER TO VI D)
----TEACHING METHOD FOR SUBJECT MATTER TYPE 1   ----
FOR NEXT QUESTIONS REFER TO VI B 3, WORKSHEET IV, TABLE C
WILL THE TEACHING METHOD BE DIVERSIFIED FOR SUBJECT MATTER  1   (Y/N)?Y
----TEACHING METHOD FOR SUBJECT MATTER TYPE 1   TRACK   1   ----
PLEASE LIST THE LEARNING EVENT TYPES TO BE USED  (P,D,CP,HW)
?  P
?  HW
?
----SUBJECT MATTER TYPE 1   PRESENTATION        TRACK   1   ----
WHICH FORMAT WILL BE USED  (AF,RF,R,S)?     R
WHICH AGENT WILL BE USED (I,L)?     I
----SUBJECT MATTER TYPE 1   HOMEWORK            TRACK   1   ----
WHICH FORMAT WILL BE USED  (AF,RF,R,S)?     RF
AGENT IS PREDEFINED AS LEARNER
----SUBJECT MATTER TYPE 1   CRITIQUE            TRACK   1   ----
FORMAT IS PREDEFINED AS GROUP INTERACTION
AGENT IS PREDEFINED AS INSTRUCTOR
** SUMMARY OF TEACHING METHODS FOR SUBJECT MATTER   1,  TRACK   1   **
L. E. TYPE          FORMAT              AGENT
----------          ------              -----
PRESENTATION        RECITATION          INSTRUCTOR
HOMEWORK            RESPONSE-PACED      LEARNER
CRITIQUE            GROUP INTERACTION   INSTRUCTOR
----TEACHING METHOD FOR SUBJECT MATTER TYPE 1   TRACK   2   ----
WILL TRACK 2 USE THE SAME METHOD AS A PREVIOUS  TRACK   (Y/N)? N
PLEASE LIST THE LEARNING EVENT TYPES TO BE USED  (P,D,CP,HW)
?  P
?  HW
?
----SUBJECT MATTER TYPE 1   PRESENTATION        TRACK   2   ----
WHICH FORMAT WILL BE USED  (AF,RF,R,S)?     AF
WHICH AGENT WILL BE USED (AP,I,L)?  AP
----SUBJECT MATTER TYPE 1   HOMEWORK            TRACK   2   ----
WHICH FORMAT WILL BE USED  (AF,RF,R,S)?     AF
AGENT IS PREDEFINED AS LEARNER
----SUBJECT MATTER TYPE 1   CRITIQUE            TRACK   2   ----
FORMAT IS PREDEFINED AS GROUP INTERACTION
AGENT IS PREDEFINED AS INSTRUCTOR
** SUMMARY OF TEACHING METHODS FOR SUBJECT MATTER   1,  TRACK   2   **
L. E. TYPE          FORMAT              AGENT
----------          ------              -----
PRESENTATION        ADAPTIVE            ADAPTIVE
HOMEWORK            ADAPTIVE            LEARNER
CRITIQUE            GROUP INTERACTION   INSTRUCTOR
----TEACHING METHOD FOR SUBJECT MATTER TYPE 1   TRACK   3   ----
WILL TRACK 3 USE THE SAME METHOD AS A PREVIOUS  TRACK   (Y/N)? Y
WHICH TRACK? 2
** REMINDER OF TEACHING METHOD FOR SUBJECT MATTER TYPE  1,   TRACK 2 **
L. E. TYPE          FORMAT              AGENT
----------          ------              -----
PRESENTATION        ADAPTIVE            ADAPTIVE
HOMEWORK            ADAPTIVE            LEARNER
CRITIQUE            GROUP INTERACTION   INSTRUCTOR
DO YOU STILL WANT THAT METHOD (Y/N)? Y
```

Fig. 8—Continued (page 3 of 6)

```
** SUMMARY OF TEACHING METHODS FOR SUBJECT MATTER   1,  TRACK   3   **
L. E. TYPE              FORMAT                  AGENT
----------              ------                  -----
PRESENTATION            ADAPTIVE                ADAPTIVE
HOMEWORK                ADAPTIVE                LEARNER
CRITIQUE                GROUP INTERACTION       INSTRUCTOR
----TEACHING METHOD FOR SUBJECT MATTER TYPE 2   ----
FOR NEXT QUESTIONS REFER TO VI C
WILL THE SAME METHOD BE USED AS A PREVIOUS SUBJECT MATTER TYPE (Y/N)? Y
THE PREVIOUS SUBJECT MATTER TYPE IS 1
****   REMINDER OF TEACHING METHOD FOR SUBJECT MATTER TYPE  1   ****
L. E. TYPE              FORMAT                  AGENT
----------              ------                  -----
------------------------TRACK   1   ------------------------
PRESENTATION            RECITATION              INSTRUCTOR
HOMEWORK                RESPONSE-PACED          LEARNER
------------------------TRACK   2   ------------------------
PRESENTATION            ADAPTIVE                ADAPTIVE
HOMEWORK                ADAPTIVE                LEARNER
------------------------TRACK   3   ------------------------
PRESENTATION            ADAPTIVE                ADAPTIVE
HOMEWORK                ADAPTIVE                LEARNER
DO YOU STILL WANT THAT METHOD (Y/N)? Y
** SUMMARY OF TEACHING METHODS FOR SUBJECT MATTER   2,  TRACK   1   **
L. E. TYPE              FORMAT                  AGENT
----------              ------                  -----
PRESENTATION            RECITATION              INSTRUCTOR
HOMEWORK                RESPONSE-PACED          LEARNER
** SUMMARY OF TEACHING METHODS FOR SUBJECT MATTER   2,  TRACK   2   **
L. E. TYPE              FORMAT                  AGENT
----------              ------                  -----
PRESENTATION            ADAPTIVE                ADAPTIVE
HOMEWORK                ADAPTIVE                LEARNER
** SUMMARY OF TEACHING METHODS FOR SUBJECT MATTER   2,  TRACK   3   **
L. E. TYPE              FORMAT                  AGENT
----------              ------                  -----
PRESENTATION            ADAPTIVE                ADAPTIVE
HOMEWORK                ADAPTIVE                LEARNER
----TEACHING METHOD FOR SUBJECT MATTER TYPE 6   ----
FOR NEXT QUESTIONS REFER TO VI B 3, WORKSHEET IV, TABLE C
WILL THE TEACHING METHOD BE DIVERSIFIED FOR SUBJECT MATTER  6   (Y/N)?Y
----TEACHING METHOD FOR SUBJECT MATTER TYPE 6   TRACK   1   ----
PLEASE LIST THE LEARNING EVENT TYPES TO BE USED  (P,GP,UP,D,CP,HW)
?  GP
?  UP
?  D
?  HW
?
----SUBJECT MATTER TYPE 6   GUIDED PRACTICE     TRACK   1   ----
WHICH FORMAT WILL BE USED  (AF,RF,R,S)?     R
WHICH AGENT WILL BE USED (I,L)?     I
----SUBJECT MATTER TYPE 6   UNGUIDED PRACTICE   TRACK   1   ----
WHICH FORMAT WILL BE USED  (R,S)?           R
WHICH AGENT WILL BE USED (I,L)?     I
----SUBJECT MATTER TYPE 6   DISCUSSION          TRACK   1   ----
FORMAT IS PREDEFINED AS GROUP INTERACTION
AGENT IS PREDEFINED AS INSTRUCTOR
----SUBJECT MATTER TYPE 6   HOMEWORK            TRACK   1   ----
```

Fig. 8—Continued (page 4 of 6)

```
WHICH FORMAT WILL BE USED  (AF,RF,R,S)?      RF
AGENT IS PREDEFINED AS LEARNER
----SUBJECT MATTER TYPE 6    REVIEW                    TRACK   1   ----
WHICH FORMAT WILL BE USED  (AF,RF,R,S,G )?  R
WHICH AGENT WILL BE USED (I,L)?      I
----SUBJECT MATTER TYPE 6    TEST                      TRACK   1   ----
WHICH FORMAT WILL BE USED  (R,S)?            S
WHICH AGENT WILL BE USED (I,L)?      L
** SUMMARY OF TEACHING METHODS FOR SUBJECT MATTER   6,  TRACK   1   **
L. E. TYPE            FORMAT                AGENT
----------            ------                -----
GUIDED PRACTICE       RECITATION            INSTRUCTOR
UNGUIDED PRACTICE     RECITATION            INSTRUCTOR
DISCUSSION            GROUP INTERACTION     INSTRUCTOR
HOMEWORK              RESPONSE-PACED        LEARNER
REVIEW                RECITATION            INSTRUCTOR
TEST                  SIMPLE                LEARNER
----TEACHING METHOD FOR SUBJECT MATTER TYPE 6   TRACK   2   ----
WILL TRACK 2 USE THE SAME METHOD AS A PREVIOUS  TRACK   (Y/N)? N
PLEASE LIST THE LEARNING EVENT TYPES TO BE USED  (P,GP,UP,D,CP,HW)
?  GP
?  UP
?  D
?  HW
?
----SUBJECT MATTER TYPE 6    GUIDED PRACTICE          TRACK   2   ----
WHICH FORMAT WILL BE USED  (AF,RF,R,S)?      AF
WHICH AGENT WILL BE USED (I,L)?      L
----SUBJECT MATTER TYPE 6    UNGUIDED PRACTICE        TRACK   2   ----
WHICH FORMAT WILL BE USED  (R,S)?            S
WHICH AGENT WILL BE USED (I,L)?      L
----SUBJECT MATTER TYPE 6    DISCUSSION               TRACK   2   ----
FORMAT IS PREDEFINED AS GROUP INTERACTION
AGENT IS PREDEFINED AS INSTRUCTOR
----SUBJECT MATTER TYPE 6    HOMEWORK                 TRACK   2   ----
WHICH FORMAT WILL BE USED  (AF,RF,R,S)?      S
AGENT IS PREDEFINED AS LEARNER
----SUBJECT MATTER TYPE 6    REVIEW                   TRACK   2   ----
WHICH FORMAT WILL BE USED  (AF,RF,R,S,G )?  G
AGENT IS PREDEFINED AS INSTRUCTOR
----SUBJECT MATTER TYPE 6    TEST                     TRACK   2   ----
WHICH FORMAT WILL BE USED  (R,S)?            S
WHICH AGENT WILL BE USED (I,L)?      L
** SUMMARY OF TEACHING METHODS FOR SUBJECT MATTER   6,  TRACK   2   **
L. E. TYPE            FORMAT                AGENT
----------            ------                -----
GUIDED PRACTICE       ADAPTIVE              LEARNER
UNGUIDED PRACTICE     SIMPLE                LEARNER
DISCUSSION            GROUP INTERACTION     INSTRUCTOR
HOMEWORK              SIMPLE                LEARNER
REVIEW                GROUP INTERACTION     INSTRUCTOR
TEST                  SIMPLE                LEARNER
----TEACHING METHOD FOR SUBJECT MATTER TYPE 6   TRACK   3   ----
WILL TRACK 3 USE THE SAME METHOD AS A PREVIOUS  TRACK   (Y/N)? Y
WHICH TRACK? 2
** REMINDER OF TEACHING METHOD FOR SUBJECT MATTER TYPE  6,   TRACK 2 **
```

Fig. 8—Continued (page 5 of 6)

```
L. E. TYPE            FORMAT              AGENT
----------            ------              -----
GUIDED PRACTICE       ADAPTIVE            LEARNER
UNGUIDED PRACTICE     SIMPLE              LEARNER
DISCUSSION            GROUP INTERACTION   INSTRUCTOR
HOMEWORK              SIMPLE              LEARNER
REVIEW                GROUP INTERACTION   INSTRUCTOR
TEST                  SIMPLE              LEARNER
DO YOU STILL WANT THAT METHOD (Y/N)? Y
** SUMMARY OF TEACHING METHODS FOR SUBJECT MATTER   6,  TRACK   3   **
L. E. TYPE            FORMAT              AGENT
----------            ------              -----
GUIDED PRACTICE       ADAPTIVE            LEARNER
UNGUIDED PRACTICE     SIMPLE              LEARNER
DISCUSSION            GROUP INTERACTION   INSTRUCTOR
HOMEWORK              SIMPLE              LEARNER
REVIEW                GROUP INTERACTION   INSTRUCTOR
TEST                  SIMPLE              LEARNER
----TEACHING METHOD FOR SUBJECT MATTER TYPE 7   ----
FOR NEXT QUESTIONS REFER TO VI B 3, WORKSHEET IV, TABLE C
WILL THE TEACHING METHOD BE DIVERSIFIED FOR SUBJECT MATTER  7   (Y/N)?N
PLEASE LIST THE LEARNING EVENT TYPES TO BE USED  (P,GP,D,CP,HW)
?  GP
?
----SUBJECT MATTER TYPE 7   GUIDED PRACTICE      ----
WHICH FORMAT WILL BE USED  (AF,RF,R,S)?     S
WHICH AGENT WILL BE USED (I,L)?     L
----SUBJECT MATTER TYPE 7   TEST                 ----
WHICH FORMAT WILL BE USED  (R,S)?           S
WHICH AGENT WILL BE USED (I,L)?     L
** SUMMARY OF TEACHING METHODS FOR SUBJECT MATTER   7,  TRACK   1   **
L. E. TYPE            FORMAT              AGENT
----------            ------              -----
GUIDED PRACTICE       SIMPLE              LEARNER
TEST                  SIMPLE              LEARNER
** SUMMARY OF TEACHING METHODS FOR SUBJECT MATTER   7,  TRACK   2   **
L. E. TYPE            FORMAT              AGENT
----------            ------              -----
GUIDED PRACTICE       SIMPLE              LEARNER
TEST                  SIMPLE              LEARNER
** SUMMARY OF TEACHING METHODS FOR SUBJECT MATTER   7,  TRACK   3   **
L. E. TYPE            FORMAT              AGENT
----------            ------              -----
GUIDED PRACTICE       SIMPLE              LEARNER
TEST                  SIMPLE              LEARNER
```

Fig. 8—Continued (page 6 of 6)

two and the number of student categories defined in the preceding phase), and the identification numbers of student categories in each track. Student categories are identified by using the category IDs assigned in the preceding phase and indicated by the arrow in Fig. 7. The UI allows the user to list as many categories of students for each track as he wishes, but it will not allow the entry of numbers that do not correspond to student categories nor of the same category in more than one track. If the user makes a mistake of these kinds, the program goes back to the first question, "How many tracks are in the course?" When the tracks have been defined, the UI summarizes the decisions and asks the user if he is satisfied with the results. If not, the sequence goes back to the first tracking question. This is one instance in which the program allows correction of an error without reinitiation of the phase.

After the tracks have been defined, if content is diversified, the user specifies which items of content listed in the "Second Expansion of Training Objectives (including Tests)" at the end of Phase 2 (see page 3 of Fig. 6) are skipped by each category of students. An example of this interaction is also shown in Fig. 8. When entries have been completed for all categories of students, the UI summarizes the results as shown in the figure. Figure 9 shows how the "Second Expansion of Training Objectives" can be used as a worksheet to guide these decisions.

The user now specifies teaching method for each subject matter type. A worksheet can be used to guide these decisions, as shown in Fig. 10. For the subject matter type in the course with the smallest type number, if tracking has been chosen, the user first indicates whether teaching method will be diversified for that subject matter type.[8] If so, he next specifies teaching method for each track, as shown on p. 3 of Fig. 8. If teaching method is not diversified for a subject matter type, he specifies teaching method for all tracks at once, as shown on p. 6 of Fig. 8.

To specify teaching method, the user first selects learning event types in the sequence in which they will be used to teach each objective[9] with this subject matter type, as shown at the top of p. 3, Fig. 8. The UI displays the allowable entries in parentheses following the question. The user may list as many of these as he wishes and may repeat any he desires. After the list of learning event types is complete, the UI requests the teaching format and teaching agent for each learning event type and for each test, review, and critique that has the given subject matter type. Again, the acceptable codes are displayed along with the questions.

The user next specifies teaching method for the same subject matter type for the next track. He may, if he wishes, assign the same method as he specified for a preceding track, as shown at the top of p. 4 of Fig. 8. If he chooses not to do so, he goes through the same process described above—selecting learning event types and assigning a teaching format and teaching agent to each type.

After teaching method has been specified for all tracks for the subject matter type with the lowest type number, the user is asked to define teaching method for the next subject matter type. He may select the same teaching method as he defined for a previous subject matter type, if he desires, as shown on p. 4 of Fig. 8. If he makes this choice, the UI recaps the teaching method previously established so that the user may decide whether it is appropriate for the subject matter type being

[8] The case where method diversification has been chosen without tracking is discussed shortly.

[9] Except for tests, reviews, and critiques, which are assumed to represent a single teaching activity.

**** SECOND EXPANSION OF TRAINING OBJECTIVES (INCLUDING TESTS) ****

SEQ	OBJECTIVE NAME	SUBJECT MATTER	STUDENT CATEGORIES S,NE.E.	S,E.E.	F,NE.E.	F,E.E.
1	TESTEQP.	1		✓		✓
2	TESTEQP.	2				✓
3	URN5CHAR	2				
4	URN5CHAR	6				
5	SERVROUT	7				
6	URN5CHAR	6				
7	SERVROUT	7				
8	TBSHPRIN	1				
9	TBSHPRIN	2				
10	TBSHURN5	7				
11	FLTCHK..	1				
12	INSTALL.	1				
13	REVUE1..	6			✓	✓
14	EXAM1...	6				
15	EXAM1...	7				
16	CRITQ1..	1				

Fig. 9—Use of "Second Expansion of Training Objectives" as worksheet for content diversification

considered.[10] (See the discussion of this point in *Options for Course Design*, Sec. VI.C.)

If the user wants to define a new teaching method for the next subject matter type, the UI again asks whether teaching method will be diversified for this subject matter type. The user specifies teaching method, as before. This process is repeated for all subject matter types in the course.

If teaching method is diversified but tracking is not used, the first step in Phase 4 is to specify diversification of content (if content is diversified), rather than to allocate student categories to tracks. Then the user specifies teaching method for each subject matter type, indicating whether teaching method will be diversified for each. For each subject matter type for which teaching method is diversified, the user allocates categories of students to groups in much the same manner as they are allocated to tracks. An example of such an interaction is shown in Fig. 11, p. 1. (Note that for different subject matter types, different allocations may be specified, as shown in Fig. 11, p. 4.) Once the student groups have been defined, teaching method is specified for each group in the same manner as for tracks, discussed earlier.

Unlike the case for tracking, if teaching method is not diversified for a particu-

[10] In some instances the previously defined teaching method is inconsistent with the subject matter type under consideration, for example when the previous subject matter type does not include a test and tests are included in the subject matter type under consideration. In such an instance, either the UI does not ask whether the same method will be used as a previous subject matter type or, after the user selects a previous subject matter type, the UI informs him that the "Teaching method of previous subject matter chosen is incompatible," and reiterates the question.

Worksheet

Specify Teaching Method for Subject Matter Types[a]

Subject Matter Type in Course	Student Categories in Group/ Track	Sequence of Learning Event Types with Teaching Format and Teaching Agent		
		LET/FMT/AGT	LET/FMT/AGT	LET/FMT/AGT
1	S,NE.E.TNG	P /R/I	HW/RF/--	
	F,NE.E.TNG	P /AF/AP	HW/AF/--	
	S,E.E.TNG & F,E.E.TNG	Same as track 2.		
2	Same as Subject Matter Type 1.			
6	S,NE.E.TNG	GP/R/I	UP/R/I	D/--/--
		HW/RF/--	R/R/I	T/S/L
	F,NE.E.TNG	GP/AF/L	UP/S/L	D/--/--
		HW/S/--	R/G/--	T/S/L
	S,E.E.TNG & F,E.E.TNG	Same as track 2.		
7	All	GP/S/L	T/S/L	

[a]Refer to the "Second Expansion of Training Objectives" to determine (1) what subject matter types are in the course and (2) which subject matter types have Reviews and Tests associated with them.

Fig. 10—Example of use of worksheet to guide specification of teaching method

```
**********************************
**** TEACHING METHOD POLICY ****
THE FOLLOWING SECTION WILL REFER FREQUENTLY TO THE SUBJECT MATTER
TYPE CODES AND THE TEACHING METHOD CODES (REFER TO VI D)
---- TEACHING METHOD FOR SUBJECT MATTER TYPE 1 ----
FOR NEXT QUESTIONS REFER TO VI B 3, WORKSHEET IV, TABLE C
WILL THE TEACHING METHOD BE DIVERSIFIED FOR SUBJECT MATTER  1   (Y/N)?Y
HOW MANY GROUPS ARE IN THE COURSE (2, 3, OR 4)?  3
PLEASE USE THE CATEGORY ID FROM THE DESCRIPTION OF STUDENT CATEGORIES
ABOVE TO ANSWER THE NEXT FEW QUESTIONS
WHICH STUDENT CATEGORIES ARE IN GROUP   1
?  1
?  3
?
WHICH STUDENT CATEGORIES ARE IN GROUP   2
?  2
?
WHICH STUDENT CATEGORIES ARE IN GROUP   3
?  4
?
**********************************************
**** SUMMARY OF GROUPING DECISIONS ****
GROUP              STUDENT
ID                 CATEGORY
1                  SLOW NON-MALE....
                   FAST NON-MALE....
2                  SLOW MALE....
3                  FAST MALE....
ARE YOU SATISFIED WITH THIS GROUPING POLICY (Y/N)? Y
---- TEACHING METHOD FOR SUBJECT MATTER TYPE 1   GROUP   1   ----
PLEASE LIST THE LEARNING EVENT TYPES TO BE USED   (P, D, CP, HW)
?  P
?  HW
?  CP
?
----SUBJECT MATTER TYPE 1    PRESENTATION          GROUP   1   ----
WHICH FORMAT WILL BE USED   (AF,RF,R,S)?     AF
WHICH AGENT WILL BE USED  (AP,I,L)?    AP
----SUBJECT MATTER TYPE 1    HOMEWORK              GROUP   1   ----
WHICH FORMAT WILL BE USED   (AF,RF,R,S)?     AF
AGENT IS PREDEFINED AS LEARNER
----SUBJECT MATTER TYPE 1    CHECK PRACTICE        GROUP   1   ----
WHICH FORMAT WILL BE USED   (R,S)?           R
WHICH AGENT WILL BE USED  (I,L)?       L
----SUBJECT MATTER TYPE 1    REVIEW                GROUP   1   ----
WHICH FORMAT WILL BE USED   (AF,RF,R,S,G)?   G
AGENT IS PREDEFINED AS INSTRUCTOR
```

Fig. 11—Describe teaching policy (grouping) (page 1 of 6)

```
** SUMMARY OF TEACHING METHODS FOR SUBJECT MATTER    1,   GROUP    1    **
L. E. TYPE          FORMAT              AGENT
----------          ------              -----
PRESENTATION        ADAPTIVE            ADAPTIVE
HOMEWORK            ADAPTIVE            LEARNER
CHECK PRACTICE      RECITATION          LEARNER
REVIEW              GROUP INTERACTION   INSTRUCTOR
----TEACHING METHOD FOR SUBJECT MATTER TYPE 1    GROUP    2    ----
WILL GROUP 2 USE THE SAME METHOD AS A PREVIOUS   GROUP    (Y/N)?  N
PLEASE LIST THE LEARNING EVENT TYPES TO BE USED   (P,D,CP,HW)
?  P
?  HW
?  CP
?
----SUBJECT MATTER TYPE 1    PRESENTATION        GROUP    2    ----
WHICH FORMAT WILL BE USED   (AF,RF,R,S)?    S
WHICH AGENT WILL BE USED  (I,L)?    I
----SUBJECT MATTER TYPE 1    HOMEWORK            GROUP    2    ----
WHICH FORMAT WILL BE USED   (AF,RF,R,S)?    AF
AGENT IS PREDEFINED AS LEARNER
----SUBJECT MATTER TYPE 1    CHECK PRACTICE      GROUP    2    ----
WHICH FORMAT WILL BE USED   (R,S)?          R
WHICH AGENT WILL BE USED  (I,L)?    L
----SUBJECT MATTER TYPE 1    REVIEW              GROUP    2    ----
WHICH FORMAT WILL BE USED   (AF,RF,R,S,G)?  S
WHICH AGENT WILL BE USED  (I,L)?    I
** SUMMARY OF TEACHING METHODS FOR SUBJECT MATTER    1,   GROUP    2    **
L. E. TYPE          FORMAT              AGENT
----------          ------              -----
PRESENTATION        SIMPLE              INSTRUCTOR
HOMEWORK            ADAPTIVE            LEARNER
CHECK PRACTICE      RECITATION          LEARNER
REVIEW              SIMPLE              INSTRUCTOR
----TEACHING METHOD FOR SUBJECT MATTER TYPE 1    GROUP    3    ----
WILL GROUP 3 USE THE SAME METHOD AS A PREVIOUS   GROUP    (Y/N)?  N
PLEASE LIST THE LEARNING EVENT TYPES TO BE USED   (P,D,CP,HW)
?  P
?  HW
?  CP
?
----SUBJECT MATTER TYPE 1    PRESENTATION        GROUP    3    ----
WHICH FORMAT WILL BE USED   (AF,RF,R,S)?    S
WHICH AGENT WILL BE USED  (I,L)?    L
----SUBJECT MATTER TYPE 1    HOMEWORK            GROUP    3    ----
WHICH FORMAT WILL BE USED   (AF,RF,R,S)?    S
AGENT IS PREDEFINED AS LEARNER
```

Fig. 11—Continued (page 2 of 6)

```
----SUBJECT MATTER TYPE 1    CHECK PRACTICE      GROUP    3    ----
WHICH FORMAT WILL BE USED   (R,S)?          S
WHICH AGENT WILL BE USED  (I,L)?     L
----SUBJECT MATTER TYPE 1    REVIEW              GROUP    3    ----
WHICH FORMAT WILL BE USED   (AF,RF,R,S,G)?  S
WHICH AGENT WILL BE USED  (I,L)?     L
** SUMMARY OF TEACHING METHODS FOR SUBJECT MATTER    1,   GROUP    3    **
L. E. TYPE          FORMAT              AGENT
----------          ------              -----
PRESENTATION        SIMPLE              LEARNER
HOMEWORK            SIMPLE              LEARNER
CHECK PRACTICE      SIMPLE              LEARNER
REVIEW              SIMPLE              LEARNER
----TEACHING METHOD FOR SUBJECT MATTER TYPE 2 ----
FOR NEXT QUESTIONS REFER TO VI B 3, WORKSHEET IV, TABLE C
WILL THE SAME METHOD BE USED AS A PREVIOUS SUBJECT MATTER TYPE (Y/N)?   Y
THE PREVIOUS SUBJECT MATTER TYPE IS 1
****   REMINDER OF TEACHING METHOD FOR SUBJECT MATTER TYPE  1   ****
L. E. TYPE          FORMAT              AGENT
----------          ------              -----
----------------------GROUP   1  ----------------------
PRESENTATION        ADAPTIVE            ADAPTIVE
HOMEWORK            ADAPTIVE            LEARNER
CHECK PRACTICE      RECITATION          LEARNER
REVIEW              GROUP INTERACTION   INSTRUCTOR
----------------------GROUP   2  ----------------------
PRESENTATION        SIMPLE              INSTRUCTOR
HOMEWORK            ADAPTIVE            LEARNER
CHECK PRACTICE      RECITATION          LEARNER
REVIEW              SIMPLE              INSTRUCTOR
----------------------GROUP   3  ----------------------
PRESENTATION        SIMPLE              LEARNER
HOMEWORK            SIMPLE              LEARNER
CHECK PRACTICE      SIMPLE              LEARNER
REVIEW              SIMPLE              LEARNER
DO YOU STILL WANT THAT METHOD (Y/N)? Y
** SUMMARY OF TEACHING METHODS FOR SUBJECT MATTER    2,   GROUP    1    **
L. E. TYPE          FORMAT              AGENT
----------          ------              -----
PRESENTATION        ADAPTIVE            ADAPTIVE
HOMEWORK            ADAPTIVE            LEARNER
CHECK PRACTICE      RECITATION          LEARNER
REVIEW              GROUP INTERACTION   INSTRUCTOR
```

Fig. 11—Continued (page 3 of 6)

```
** SUMMARY OF TEACHING METHODS FOR SUBJECT MATTER   2,    GROUP    2    **
L. E. TYPE          FORMAT              AGENT
----------          ------              -----
PRESENTATION        SIMPLE              INSTRUCTOR
HOMEWORK            ADAPTIVE            LEARNER
CHECK PRACTICE      RECITATION          LEARNER
REVIEW              SIMPLE              INSTRUCTOR
** SUMMARY OF TEACHING METHODS FOR SUBJECT MATTER   2,    GROUP    3    **
L. E. TYPE          FORMAT              AGENT
----------          ------              -----
PRESENTATION        SIMPLE              LEARNER
HOMEWORK            SIMPLE              LEARNER
CHECK PRACTICE      SIMPLE              LEARNER
REVIEW              SIMPLE              LEARNER
----TEACHING METHOD FOR SUBJECT MATTER TYPE 5 ----
FOR NEXT QUESTIONS REFER TO VI B 3, WORKSHEET IV, TABLE C
WILL THE TEACHING METHOD BE DIVERSIFIED FOR SUBJECT MATTER  5  (Y/N)? N
PLEASE LIST THE LEARNING EVENT TYPES TO BE USED  (P,GP,UP,D,CP,HW)
?  P
?  GP
?  HW
?  D
?  CP
?
----SUBJECT MATTER TYPE 5    PRESENTATION        ----
WHICH FORMAT WILL BE USED   (AF,RF,R,S)?    AF
WHICH AGENT WILL BE USED  (AP,I,L)?  I
----SUBJECT MATTER TYPE 5    GUIDED PRACTICE     ----
WHICH FORMAT WILL BE USED   (AF,RF,R,S)?    AF
WHICH AGENT WILL BE USED  (AP,I,L)?  I
----SUBJECT MATTER TYPE 5    HOMEWORK            ----
WHICH FORMAT WILL BE USED   (AF,RF,R,S)?    AF
AGENT IS PREDEFINED AS LEARNER
----SUBJECT MATTER TYPE 5    DISCUSSION          ----
FORMAT IS PREDEFINED AS GROUP INTERACTION
AGENT IS PREDEFINED AS INSTRUCTOR
----SUBJECT MATTER TYPE 5    CHECK PRACTICE      ----
WHICH FORMAT WILL BE USED   (R,S)?          R
WHICH AGENT WILL BE USED  (I,L)?     L
** SUMMARY OF TEACHING METHODS FOR SUBJECT MATTER   5   **
L. E. TYPE          FORMAT              AGENT
----------          ------              -----
PRESENTATION        ADAPTIVE            INSTRUCTOR
GUIDED PRACTICE     ADAPTIVE            INSTRUCTOR
HOMEWORK            ADAPTIVE            LEARNER
DISCUSSION          GROUP INTERACTION   INSTRUCTOR
CHECK PRACTICE      RECITATION          LEARNER
```

Fig. 11—Continued (page 4 of 6)

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----TEACHING METHOD FOR SUBJECT MATTER TYPE 6  ----
FOR NEXT QUESTIONS REFER TO VI B 3, WORKSHEET IV, TABLE C
WILL THE TEACHING METHOD BE DIVERSIFIED FOR SUBJECT MATTER  6   (Y/N)? Y
HOW MANY GROUPS ARE IN THE COURSE (2, 3, OR 4)?  2
PLEASE USE THE CATEGORY ID FROM THE DESCRIPTION OF STUDENT CATEGORIES
ABOVE TO ANSWER THE NEXT FEW QUESTIONS
WHICH STUDENT CATEGORIES ARE IN GROUP   1
?  1
?  2
?
WHICH STUDENT CATEGORIES ARE IN GROUP   2
?  3
?  4
?
****************************************
**** SUMMARY OF GROUPING DECISIONS ****
GROUP              STUDENT
ID                 CATEGORY
1                  SLOW NON-MALE....
                   SLOW MALE....
2                  FAST NON-MALE....
                   FAST MALE....
ARE YOU SATISFIED WITH THIS GROUPING POLICY (Y/N)? Y
----TEACHING METHOD FOR SUBJECT MATTER TYPE 6    GROUP    1    ----
PLEASE LIST THE LEARNING EVENT TYPES TO BE USED   (P,GP,UP,D,CP,HW)
?  P
?  GP
?  UP
?  HW
?  CP
?
----SUBJECT MATTER TYPE 6    PRESENTATION          GROUP    1    ----
WHICH FORMAT WILL BE USED   (AF,RF,R,S)?    S
WHICH AGENT WILL BE USED  (I,L)?     I
----SUBJECT MATTER TYPE 6    GUIDED PRACTICE       GROUP    1    ----
WHICH FORMAT WILL BE USED   (AF,RF,R,S)?    S
WHICH AGENT WILL BE USED  (I,L)?     I
----SUBJECT MATTER TYPE 6    UNGUIDED PRACTICE     GROUP    1    ----
WHICH FORMAT WILL BE USED   (R,S)?      R
WHICH AGENT WILL BE USED  (I,L)?     I
----SUBJECT MATTER TYPE 6    HOMEWORK              GROUP    1    ----
WHICH FORMAT WILL BE USED   (AF,RF,R,S)?    AF
AGENT IS PREDEFINED AS LEARNER
----SUBJECT MATTER TYPE 6    CHECK PRACTICE        GROUP    1    ----
WHICH FORMAT WILL BE USED   (R,S)?          R
WHICH AGENT WILL BE USED  (I, L)?    I
----SUBJECT MATTER TYPE 6    TEST                  GROUP    1    ----
WHICH FORMAT WILL BE USED   (R,S)?          R
WHICH AGENT WILL BE USED  (I,L)?     L
```

Fig. 11—Continued (page 5 of 6)

```
** SUMMARY OF TEACHING METHODS FOR SUBJECT MATTER    6,   GROUP    1    **
L. E. TYPE            FORMAT              AGENT
----------            ------              -----
PRESENTATION          SIMPLE              INSTRUCTOR
GUIDED PRACTICE       SIMPLE              INSTRUCTOR
UNGUIDED PRACTICE     RECITATION          INSTRUCTOR
HOMEWORK              ADAPTIVE            LEARNER
CHECK PRACTICE        RECITATION          INSTRUCTOR
TEST                  RECITATION          LEARNER
----TEACHING METHOD FOR SUBJECT MATTER TYPE 6     GROUP    2    ----
WILL GROUP 2 USE THE SAME METHOD AS A PREVIOUS    GROUP    (Y/N)? N
PLEASE LIST THE LEARNING EVENT TYPES TO BE USED   (P,GP,UP,D,CP,HW)
? P
? HW
? CP
?
----SUBJECT MATTER TYPE 6    PRESENTATION         GROUP    2    ----
WHICH FORMAT WILL BE USED   (AF,RF,R,S)?    AF
WHICH AGENT WILL BE USED  (AP,I,L)? L
----SUBJECT MATTER TYPE 6    HOMEWORK             GROUP    2    ----
WHICH FORMAT WILL BE USED   (AF,RF,R,S)?    AF
AGENT IS PREDEFINED AS LEARNER
----SUBJECT MATTER TYPE 6    CHECK PRACTICE       GROUP    2    ----
WHICH FORMAT WILL BE USED   (R,S)?          R
WHICH AGENT WILL BE USED  (I,L)?    L
----SUBJECT MATTER TYPE 6    TEST                 GROUP    2    ----
WHICH FORMAT WILL BE USED   (R,S)?          R
WHICH AGENT WILL BE USED  (I,L)?    L
** SUMMARY OF TEACHING METHODS FOR SUBJECT MATTER    6,   GROUP    2    **
L. E. TYPE            FORMAT              AGENT
----------            ------              -----
PRESENTATION          ADAPTIVE            LEARNER
HOMEWORK              ADAPTIVE            LEARNER
CHECK PRACTICE        RECITATION          LEARNER
TEST                  RECITATION          LEARNER
```

Fig. 11—Continued (page 6 of 6)

lar subject matter type, the UI assumes that all students are in a single group taught by the same teaching method, as shown in Fig. 11, p. 4. (Recall that in the case of tracking, students remain in separate tracks, even when they are all taught by the same method.) If neither tracking nor method diversification is chosen, the user specifies teaching method for each subject matter type for all students at once.

The final step in Phase 4 is carried out entirely by the program. It is to associate the specifications of content diversification, tracking or grouping, and teaching method with the appropriate entries in the "Second Expansion of Training Objectives (including Tests)" to create a "Final List of Learning Events." The program expands each objective (except tests, reviews, and critiques) into a sequence of learning events, with one learning event for each learning event type for each group or track eligible to take the objective—i.e., not excluded by the decisions on content diversification. Reviews, tests, and critiques are converted one-for-one into learning events. This expanded list is displayed for the user. Figure 12a shows portions of the expansion associated with Fig. 8; Fig. 12b shows a similar expansion for Fig. 11.

**** FINAL LIST OF LEARNING EVENTS ****

L.E. NUM	NAME	SUBJ MATR	L. E. TYPE	TCHG FORM	TCHG AGENT	SLOW NO-E	SLOW E.E.	FAST NO-E	FAST E.E.
				TRACK 1					
1	TESTEQP.	1	P	R	I	X			
2			HW	RF	L	X			
3	TESTEQP.	2	P	R	I	X			
4			HW	RF	L	X			
5	URN5CHAR	2	P	R	I	X			
6			HW	RF	L	X			
7	URN5CHAR	6	GP	R	I	X			
8			UP	R	I	X			
9			D	G	I	X			
10			HW	RF	L	X			
11	SERVROUT	7	GP	S	L	X			
12	URN5CHAR	6	GP	R	I	X			
13			UP	R	I	X			
14			D	G	I	X			
15			HW	RF	L	X			
16	SERVROUT	7	GP	S	L	X			
17	TBSHPRIN	1	P	R	I	X			
18			HW	RF	L	X			
19	TBSHPRIN	2	P	R	I	X			
20			HW	RF	L	X			
21	TBSHURN5	7	GP	S	L	X			
22	FLTCHK..	1	P	R	I	X			
23			HW	RF	L	X			
24	INSTALL.	1	P	R	I	X			
25			HW	RF	L	X			
26	REVUE1..	6	R	R	I	X			
27	EXAM1...	6	T	S	L	X			
28	EXAM1...	7	T	S	L	X			
29	CRITQ1..	1	C	G	I	X			

Fig. 12a—Final list of learning events for Fig. 8 (page 1 of 2)

				TRACK 2						
30	TESTEQP.	1	P	AF	AP			X		
31			HW	AF	L			X		
32	TESTEQP.	2	P	AF	AP			X		
33			HW	AF	L			X		
34	URN5CHAR	2	P	AF	AP			X		
35			HW	AF	L			X		
36	URN5CHAR	6	GP	AF	L			X		
37			UP	S	L			X		
38			D	G	I			X		
39			HW	S	L			X		
40	SERVROUT	7	GP	S	L			X		
41	URN5CHAR	6	GP	AF	L			X		
42			UP	S	L			X		
43			D	G	I			X		
44			HW	S	L			X		
45	SERVROUT	7	GP	S	L			X		
46	TBSHPRIN	1	P	AF	AP			X		
47			HW	AF	L			X		
48	TBSHPRIN	2	P	AF	AP			X		
49			HW	AF	L			X		
50	TBSHURN5	7	GP	S	L			X		
51	FLTCHK..	1	P	AF	AP			X		
52			HW	AF	L			X		
53	INSTALL.	1	P	AF	AP			X		
54			HW	AF	L			X		
55	EXAM1...	6	T	S	L			X		
56	EXAM1...	7	T	S	L			X		
57	CRITQ1..	1	C	G	I			X		
				TRACK 3						
58	TESTEQP.	2	P	AF	AP	X				
59			HW	AF	L	X				
60	URN5CHAR	2	P	AF	AP	X			X	
61			HW	AF	L	X			X	
62	URN5CHAR	6	GP	AF	L	X			X	
63			UP	S	L	X			X	
64			D	G	I	X			X	
65			HW	S	L	X			X	
66	SERVROUT	7	GP	S	L	X			X	
67	URN5CHAR	6	GP	AF	L	X			X	
68			UP	S	L	X			X	
69			D	G	I	X			X	
70			HW	S	L	X			X	
71	SERVROUT	7	GP	S	L	X			X	
72	TBSHPRIN	1	P	AF	AP	X			X	
73			HW	AF	L	X			X	
74	TBSHPRIN	2	P	AF	AP	X			X	
75			HW	AF	L	X			X	
76	TBSHURN5	7	GP	S	L	X			X	
77	FLTCHK..	1	P	AF	AP	X			X	
78			HW	AF	L	X			X	
79	INSTALL.	1	P	AF	AP	X			X	
80			HW	AF	L	X				
81	REVUE1..	6	R	G	I	X			X	
82	EXAM1...	6	T	S	L	X			X	
83	EXAM1...	7	T	S	L	X			X	
84	CRITQ1..	1	C	G	I	X				

Fig. 12a—Continued (page 2 of 2)

**** FINAL LIST OF LEARNING EVENTS ****

L.E. NUM	NAME	SUBJ MATR	L. E. TYPE	TCHG FORM	TCHG AGENT	SLOW NO-M	SLOW MALE	FAST NO-M	FAST MALE
			LEARNING EVENTS			STUDENT CATEGORIES			
1	ORIENT..	6	P	S	I	X	X		
2			GP	S	I	X	X		
3			UP	R	I	X	X		
4			HW	AF	L	X	X		
5			CP	R	I	X	X		
6	ORIENT..	6	P	AF	L			X	X
7			HW	AF	L			X	X
8			CP	R	L			X	X
9	ORIENT..	1	P	AF	AP	X		X	
10			HW	AF	L	X		X	
11			CP	R	L	X		X	
12	ORIENT..	1	P	S	I		X		
13			HW	AF	L		X		
14			CP	R	L		X		
15	ORIENT..	1	P	S	L				X
16			HW	S	L				X
17			CP	S	L				X
18	AN/URN5.	2	P	AF	AP	X		X	
19			HW	AF	L	X		X	
20			CP	R	L	X		X	
21	AN/URN5.	2	P	S	I		X		
22			HW	AF	L		X		
23			CP	R	L		X		
24	AN/URN5.	2	P	S	L				X
25			HW	S	L				X
26			CP	S	L				X
27	AN/URN5.	5	P	AF	I	X	X	X	X
28			GP	AF	I	X	X	X	X
29			HW	AF	L	X	X	X	X
30			D	G	I	X	X	X	X
31			CP	R	L	X	X	X	X
32	REVIEW1.	1	R	G	I	X		X	
33	REVIEW1.	1	R	S	I		X		
34	REVIEW1.	1	R	S	L				X
35	REVIEW1.	2	R	G	I	X		X	
36	REVIEW1.	2	R	S	I		X		
37	REVIEW1.	2	R	S	L				X
38	EXAM1...	6	T	R	L	X	X		
39	EXAM1...	6	T	R	L			X	X

Fig. 12b—Final list of learning events for Fig. 11

The "Final List of Learning Events" should be saved for reference in the next two phases. It may be used as a worksheet, if desired; in that event, the user should double space the printing for this report immediately after the title is printed. (To conserve space, figures in this report have not been double spaced.)

DESCRIBE TEST DETAILS—PHASE 5

If tests are included in the course plan, specifics of their effects are described here. First, the user indicates how failures are distributed among student categories, if such categories were established in Phase 3, *Describe Student Population and Course Diversification.* He does this by entering the proportion of all failing students that may be expected to come from each student category. A series of such entries is shown in Fig. 13. Note that the UI asks for entries for one less than the number of categories to insure that the sum is 100 percent. Note also that the user may revise his entries if he is not satisfied with the result displayed by the UI.[11]

Next, the UI displays each test in the course, referring to the "Final List of Learning Events" produced at the end of the preceding phase, and asks the user to indicate whether there will be failures (if there are failures in the course) or recycles (if there are recycles in the course) associated with the test. If there are recycles, the user enters the percent of passing students that will recycle from this test and the number of the learning event to which they go back. The user should be sure to identify at least one test as failable for each category of students from which failures may come; otherwise the RUM will be unable to produce the overall failure rate specified. Figure 14 illustrates the use of the "Final List of Learning Events" as a worksheet to guide these decisions.

DESCRIBE RESOURCES—PHASE 6

Overview

In this phase the user allocates resources to learning events. First, he assigns special resources to learning events with subject matter type 7 or greater. Next, he allocates non-special resources (instructors, evaluators, monitors, facilities, media, and recording hardware) in a series of interactions with the program. The UI displays the result of the assignment of each type of resource if the user wishes. After all assignments have been made, the UI recapitulates them in a "Total Resource Assignment Report." At this point, the user may add or delete resources to or from any learning event he wishes.

[11] In some instances, this procedure could lead to the assignment of failure rates that are impossible to fulfill. To illustrate, suppose that students are broken into three groups: slow (15 percent), average (70 percent), and fast (15 percent). Suppose, further, that the overall rate of failure for the course is 20 percent. If the user were to estimate that 90 percent of the failures are accounted for by the slow group, this would mean that 18 percent of the total student population that fails ($.90 \times .20 = .18$) would come from the slow group. But this is impossible, because only 15 percent of total student population is in the slow group.

The RUM will still operate in such a situation, but it will be unable to produce the overall failure rate specified. To avoid this problem, check the failure distribution for consistency before entering it, by comparing the product of (the overall failure rate) and (the percent of failures accounted for by a given category) with (the percent of students in that category) to make sure that there are enough students to make up the failure rate specified.

```
**********************************
**** FAILURE DISTRIBUTION ****
PLEASE ENTER THE FRACTIONAL PORTION OF THE COURSE FAILURES CONTRIBUTED
BY EACH STUDENT CATEGORY (REFER TO VII A 1)
CATEGORY              PERCENT
--------              -------
SLOW NON-E.E.TNG. ? 50
SLOW E.E.TNG.     ? 30
FAST NON-E.E.TNG. ? 10
******************************************
**** DISTRIBUTION OF FAILURES SUMMARY ****
STUDENT CATEGORY    PERCENTAGE OF FAILURES
----------------    ----------------------
SLOW NON-E.E.TNG.              50
SLOW E.E.TNG.                  30
FAST NON-E.E.TNG.              10
FAST E.E.TNG.                  10
ARE YOU SATISFIED WITH THIS DISTRIBUTION (Y/N)? Y
****************************************
**** TEST FAILURES, RECYCLE POINTS ****
REFER TO VII A 2(FAILURES), VII B, VII B 1,2(RECYCLES)
--------EXAM1...  TRACK 1   L.E.NUM  28 --------
WILL THERE BE FAILURES (Y/N)? Y
WILL THERE BE RECYCLES (Y/N)? Y
WHAT PERCENT RECYCLE FROM THIS EXAM ? 20
RECYCLE TO L. E. NUM? 5
--------EXAM1...  TRACK 2   L.E.NUM  56 --------
WILL THERE BE FAILURES (Y/N)? Y
WILL THERE BE RECYCLES (Y/N)? Y
WHAT PERCENT RECYCLE FROM THIS EXAM ? 5
RECYCLE TO L. E. NUM? 34
--------EXAM1...  TRACK 3   L.E.NUM  83 --------
WILL THERE BE FAILURES (Y/N)? Y
WILL THERE BE RECYCLES (Y/N)? Y
WHAT PERCENT RECYCLE FROM THIS EXAM ? 5
RECYCLE TO L. E. NUM? 60
```

Fig. 13—Describe test details

Discussion

The first interaction in this phase is the collection of special resources to be assigned to learning events with subject matter type 7, 8, 9, or 10. As shown in Fig. 15, the UI prompts the user by displaying each such learning event in sequence, along with its sequence number from the "Final List of Learning Events," asking the user to list special resources for each in turn. Figure 16 shows how the "Final List of Learning Events" may be used as a worksheet to help guide these decisions.

The total number of resources of all kinds that may be entered in the UI may not exceed 31. Since the user will probably want to consider resources other than special resources, such as instructors and classrooms, he will usually want to enter fewer than 31 special resources at this point. As many resources as desired (up to 31) or none may be entered for each learning event. To enter no resources for a learning event, simply respond to the first ? with a carriage return.

In contrast to codes for objectives, the UI recognizes resources only on the basis of the codes that designate them, not on the basis of the sequence in which they

**** FINAL LIST OF LEARNING EVENTS ****

L.E. NUM	NAME	SUBJ MATR	L. E. TYPE	TCHG FORM	TCHG AGENT	STUDENT CATEGORIES: SLOW NO-E	SLOW E.E.	FAST NO-E	FAST E.E.	EXAMS: FAIL?	RECYCLE?	% REC?	TO LE NO.?
				TRACK 1									
1	TESTEQP.	1	P	R	I	X							
2			HW	RF	L	X							
3	TESTEQP.	2	P	R	I	X							
4			HW	RF	L	X							
5	URN5CHAR	2	P	R	I	X							
6			HW	RF	L	X							
7	URN5CHAR	6	GP	R	I	X							
8			UP	R	I	X							
9			D	G	I	X							
10			HW	RF	L	X							
11	SERVROUT	7	GP	S	L	X							
12	URN5CHAR	6	GP	R	I	X							
13			UP	R	I	X							
14			D	G	I	X							
15			HW	RF	L	X							
16	SERVROUT	7	GP	S	L	X							
17	TBSHPRIN	1	P	R	I	X							
18			HW	RF	L	X							
19	TBSHPRIN	2	P	R	I	X							
20			HW	RF	L	X							
21	TBSHURN5	7	GP	S	L	X							
22	FLTCHK..	1	P	R	I	X							
23			HW	RF	L	X							
24	INSTALL.	1	P	R	I	X							
25			HW	RF	L	X							
26	REVUE1..	6	R	R	I	X							
27	EXAM1...	6	T	S	L	X							
28	EXAM1...	7	T	S	L	X				Y	Y	20	5
29	CRITQ1..	1	C	G	I	X							

Fig. 14—Use of "Final List of Learning Events" (partial) as worksheet for specifying test details

```
*****************************************
****  SPECIAL RESOURCES ASSIGNMENT  ****
PLEASE NAME SPECIAL RESOURCES FOR SUBJECT MATTER TYPES 7-10
L.E.NUM     S.M.TYPE
--------------------
   11            7
?  ANURN5
?  TSNR1
?  TSNR2
?  SIGGEN
?
   16            7
?  ANURN5
?  TSNR1
?  TSNR2
?  SIGGEN
?
   21            7
?  ANURN5
?  TSNR1
?  TSNR2
?  SIGGEN
?
   28            7
?  ANURN5
?  TSNR1
?  TSNR2
?  SIGGEN
?
   40            7
?  ANURN5
?  TSNR1
?  TSNR2
?  SIGGEN
?
   45            7
?  ANURN5
?  TSNR1
?  TSNR2
?  SIGGEN
?
   50            7
?  ANURN5
?  TSNR1
?  TSNR2
?  SIGGEN
?
   56            7
?  ANURN5
?  TSNR1
?  TSNR2
?  SIGGEN
?
   66            7
?  ANURN5
?  TSNR1
?  TSNR2
?  SIGGEN
?
```

Fig. 15—Describe resources (page 1 of 7)

```
  71          7
?  ANURN5
?  TSNR1
?  TSNR2
?  SIGGEN
?
  76          7
?  ANURN5
?  TSNR1
?  TSNR2
?  SIGGEN
?
  83          7
?  ANURN5
?  TSNR1
?  TSNR2
?  SIGGEN
?
DO YOU WISH TO SEE THE ASSIGNMENT (Y/N)? Y
**********************
**** SPECIAL RESOURCES ****
 -------LEARNING EVENTS-------  STUD.CAT.-  -RESOURCES-
L.E          S M L.E TCHG TCHG  SL SL FS FS
NUM NAME     TYP TYP FORM AGENT NE E  NE E     NAME
--- ----     --- --- ---- ----- -- -- -- --     ----
---------------  TRACK 1  ----------------
 11 SERVROUT 7   GP  S    L    X             ANURN5
                                             TSNR1
                                             TSNR2
                                             SIGGEN
 16 SERVROUT 7   GP  S    L    X             ANURN5
                                             TSNR1
                                             TSNR2
                                             SIGGEN
 21 TBSHURN5 7   GP  S    L    X             ANURN5
                                             TSNR1
                                             TSNR2
                                             SIGGEN
 28 EXAM1... 7   T   S    L    X             ANURN5
                                             TSNR1
                                             TSNR2
                                             SIGGEN
---------------  TRACK 2  ----------------
 40 SERVROUT 7   GP  S    L         X        ANURN5
                                             TSNR1
                                             TSNR2
                                             SIGGEN
 45 SERVROUT 7   GP  S    L         X        ANURN5
                                             TSNR1
                                             TSNR2
                                             SIGGEN
 50 TBSHURN5 7   GP  S    L         X        ANURN5
                                             TSNR1
                                             TSNR2
                                             SIGGEN
 56 EXAM1... 7   T   S    L         X        ANURN5
                                             TSNR1
                                             TSNR2
                                             SIGGEN
```

Fig. 15—Continued (page 2 of 7)

```
-------------.---   TRACK 3   ---------------
 66 SERVROUT 7   GP  S     L       X     X  ANURN5
                                            TSNR1
                                            TSNR2
                                            SIGGEN
 71 SERVROUT 7   GP  S     L       X     X  ANURN5
                                            TSNR1
                                            TSNR2
                                            SIGGEN
 76 TBSHURN5 7   GP  S     L       X     X  ANURN5
                                            TSNR1
                                            TSNR2
                                            SIGGEN
 83 EXAM1... 7   T   S     L       X     X  ANURN5
                                            TSNR1
                                            TSNR2
                                            SIGGEN

WOULD YOU LIKE TO SEE THE RESOURCE ASSIGNMENT POLICY CODES (Y/N)? Y
**********************************************
**** RESOURCE ASSIGNMENT POLICY CODES **** (REFER TO VIII B)
W - WHOLE COURSE
B - BLOCK
SM - SUBJECT MATTER TYPE
LET - LEARNING EVENT TYPE
T - TRACK
SMLE - SUBJ. MATTER AND LEARNING EVENT TYPE
SMGT - SUBJ. MATTER AND STUDENT GROUP/TRACK
SMLS - SUBJ. MATTER, LEARNING EVENT TYPE, AND STUDENT GROUP/TRACK
LE - INDIVIDUAL LEARNING EVENT
N - NONE


**************************************
**** IDENTIFYING INSTRUCTOR TYPES **** (REFER TO VIII C)
ASSIGN RESOURCE BY (W, B, SM, T, SMLE, SMGT, SMLS, LE)?          W
*** ENTRY MUST BE MADE FOR EVERY PROMPT
PLEASE NAME THE RESOURCE? INSTRCTR
DO YOU WISH TO SEE THE ASSIGNMENT (Y/N)? N
**********************************
**** IDENTIFYING EVALUATORS **** (REFER TO VIII D)
ASSIGN RESOURCE BY (W, B, SM, T, SMLE, SMGT, SMLS, LE, N)?       SMLE
PLEASE NAME THE RESOURCE FOR EACH SUBJ. MATTER TYPE AND
LEARNING EVENT TYPE
SUBJECT     LEARNING
MATTER      EVENT
TYPE        TYPE          RESOURCE
--------    --------      --------
  1         CRITIQUE      ? EVALUATR
  6         TEST          ?
  7         TEST          ? EVALUATR
```

Fig. 15—Continued (page 3 of 7)

```
DO YOU WISH TO SEE THE ASSIGNMENT (Y/N)? Y
*********************************
**** EVALUATOR ASSIGNMENT ****
 -------LEARNING EVENTS-------  STUD.CAT.- -RESOURCES-
L.E                S M L.E TCHG TCHG  SL SL FS FS
NUM NAME     TYP   TYP TYP FORM AGENT NE E  NE E      NAME
--- ----     ---   --- --- ---- ----- -- -- -- --      ----
---------------   TRACK 1   ---------------
 28 EXAM1... 7    T   S       L     X                 EVALUATR
 29 CRITQ1.. 1    C   G       I     X                 EVALUATR
---------------   TRACK 2   ---------------
 56 EXAM1... 7    T   S       L           X           EVALUATR
 57 CRITQ1.. 1    C   G       I           X           EVALUATR
---------------   TRACK 3   ---------------
 83 EXAM1... 7    T   S       L        X     X       EVALUATR
 84 CRITQ1.. 1    C   G       I        X     X       EVALUATR
*********************************
**** IDENTIFYING MONITORS **** (REFER TO VIII E)
ASSIGN RESOURCE BY (W, B, SM, T, SMLE, SMGT, SMLS, LE, N)?       SMLS
PLEASE NAME THE RESOURCE FOR EACH SUBJ. MATTER TYPE
LEARNING EVENT TYPE, AND TRACK
SUBJECT            LEARNING
MATTER             EVENT      SL SL FS FS
TYPE       TRACK   TYPE       NE E  NE E   RESOURCE
-------    -----   --------   -- -- -- --  --------
    1        2     PRES.                X   ? RM2.MON
    1        3     PRES.           X        X ? RM3.MON
    2        2     PRES.                X   ? RM2.MON
    2        3     PRES.           X        X ? RM3.MON
    6        1     TEST       X             ? INSTRCTR
    6        2     GU.PR.               X   ? RM2.MON
    6        2     UNG.P.               X   ? RM2.MON
    6        2     TEST                 X   ? RM2.MON
    6        3     GU.PR.          X        X ? RM3.MON
    6        3     UNG.P.          X        X ? RM3.MON
    6        3     TEST            X        X ? RM3.MON
    7        1     GU.PR.     X             ? LAB.MON
    7        1     TEST       X             ?
    7        2     GU.PR.               X   ? LAB.MON
    7        2     TEST                 X   ?
    7        3     GU.PR.          X        X ? LAB.MON
    7        3     TEST            X        X ?
DO YOU WISH TO SEE THE ASSIGNMENT (Y/N)? Y
*********************************
**** MONITOR ASSIGNMENT ****
 -------LEARNING EVENTS-------  STUD.CAT.- -RESOURCES-
L.E                S M L.E TCHG TCHG  SL SL FS FS
NUM NAME     TYP   TYP TYP FORM AGENT NE E  NE E      NAME
--- ----     ---   --- --- ---- ----- -- -- -- --      ----
---------------   TRACK 1   ---------------
  1 TESTEQP. 1    P   R       I     X                 INSTRCTR
  3 TESTEQP. 2    P   R       I     X                 INSTRCTR
  5 URN5CHAR 2    P   R       I     X                 INSTRCTR
  7 URN5CHAR 6    GP  R       I     X                 INSTRCTR
  8 URN5CHAR 6    UP  R       I     X                 INSTRCTR
  9 URN5CHAR 6    D   G       I     X                 INSTRCTR
 11 SERVROUT 7    GP  S       L     X                 LAB.MON
 12 URN5CHAR 6    GP  R       I     X                 INSTRCTR
 13 URN5CHAR 6    UP  R       I     X                 INSTRCTR
 14 URN5CHAR 6    D   G       I     X                 INSTRCTR
 16 SERVROUT 7    GP  S       L     X                 LAB.MON
 17 TBSHPRIN 1    P   R       I     X                 INSTRCTR
```

Fig. 15—Continued (page 4 of 7)

19	TBSHPRIN	2	P	R	I	X		INSTRCTR
21	TBSHURN5	7	GP	S	L	X		LAB.MON
22	FLTCHK..	1	P	R	I	X		INSTRCTR
24	INSTALL.	1	P	R	I	X		INSTRCTR
26	REVUE1..	6	R	R	I	X		INSTRCTR
27	EXAM1...	6	T	S	L	X		INSTRCTR
29	CRITQ1..	1	C	G	I	X		INSTRCTR
				TRACK 2				
30	TESTEQP.	1	P	AF	AP		X	RM2.MON
32	TESTEQP.	2	P	AF	AP		X	RM2.MON
34	URN5CHAR	2	P	AF	AP		X	RM2.MON
36	URN5CHAR	6	GP	AF	L		X	RM2.MON
37	URN5CHAR	6	UP	S	L		X	RM2.MON
38	URN5CHAR	6	D	G	I		X	INSTRCTR
40	SERVROUT	7	GP	S	L		X	LAB.MON
41	URN5CHAR	6	GP	AF	L		X	RM2.MON
42	URN5CHAR	6	UP	S	L		X	RM2.MON
43	URN5CHAR	6	D	G	I		X	INSTRCTR
45	SERVROUT	7	GP	S	L		X	LAB.MON
46	TBSHPRIN	1	P	AF	AP		X	RM2.MON
48	TBSHPRIN	2	P	AF	AP		X	RM2.MON
50	TBSHURN5	7	GP	S	L		X	LAB.MON
51	FLTCHK..	1	P	AF	AP		X	RM2.MON
53	INSTALL.	1	P	AF	AP		X	RM2.MON
55	EXAM1...	6	T	S	L		X	RM2.MON
57	CRITQ1..	1	C	G	I		X	INSTRCTR
				TRACK 3				
58	TESTEQP.	2	P	AF	AP	X		RM3.MON
60	URN5CHAR	2	P	AF	AP	X	X	RM3.MON
62	URN5CHAR	6	GP	AF	L	X	X	RM3.MON
63	URN5CHAR	6	UP	S	L	X	X	RM3.MON
64	URN5CHAR	6	D	G	I	X	X	INSTRCTR
66	SERVROUT	7	GP	S	L	X	X	LAB.MON
67	URN5CHAR	6	GP	AF	L	X	X	RM3.MON
68	URN5CHAR	6	UP	S	L	X	X	RM3.MON
69	URN5CHAR	6	D	G	I	X	X	INSTRCTR
71	SERVROUT	7	GP	S	L	X	X	LAB.MON
72	TBSHPRIN	1	P	AF	AP	X	X	RM3.MON
74	TBSHPRIN	2	P	AF	AP	X	X	RM3.MON
76	TBSHURN5	7	GP	S	L	X	X	LAB.MON
77	FLTCHK..	1	P	AF	AP	X	X	RM3.MON
79	INSTALL.	1	P	AF	AP	X	X	RM3.MON
81	REVUE1..	6	R	G	I	X		INSTRCTR
82	EXAM1...	6	T	S	L	X	X	RM3.MON
84	CRITQ1..	1	C	G	I	X	X	INSTRCTR

Fig. 15—Continued (page 5 of 7)

```
**********************************
**** IDENTIFYING FACILITIES **** (REFER TO VIII F)
ASSIGN RESOURCE BY (W, B, SM, T, SMLE, SMGT, SMLS, LE, N)?      SMLS
PLEASE NAME THE RESOURCE FOR EACH SUBJ. MATTER TYPE
LEARNING EVENT TYPE, AND TRACK
SUBJECT          LEARNING
MATTER           EVENT      SL SL FS FS
TYPE      TRACK  TYPE       NE E  NE E   RESOURCE
-------   -----  --------   -- -- -- --  --------
    1         1  PRES.      X                ? ROOM1
    1         1  CRITQ.     X                ? ROOM1
    1         2  PRES.               X       ? ROOM2
    1         2  CRITQ.              X       ? ROOM2
    1         3  PRES.         X        X    ? ROOM3
    1         3  CRITQ.        X        X    ? ROOM3
    2         1  PRES.      X                ? ROOM1
    2         2  PRES.               X       ? ROOM2
    2         3  PRES.         X        X    ? ROOM3
    6         1  GU.PR.     X                ? ROOM1
    6         1  UNG.P.     X                ? ROOM1
    6         1  DISC.      X                ? ROOM1
    6         1  REVIEW     X                ? ROOM1
    6         1  TEST       X                ? ROOM1
    6         2  GU.PR.              X       ? ROOM2
    6         2  UNG.P.              X       ? ROOM2
    6         2  DISC.               X       ? ROOM2
    6         2  TEST                X       ? ROOM2
    6         3  GU.PR.         X        X    ? ROOM3
    6         3  UNG.P.         X        X    ? ROOM3
    6         3  DISC.          X        X    ? ROOM3
    6         3  REVIEW         X        X    ? ROOM3
    6         3  TEST           X        X    ? ROOM3
    7         1  GU.PR.     X                ? LAB
    7         1  TEST       X                ? LAB
    7         2  GU.PR.              X       ? LAB
    7         2  TEST                X       ? LAB
    7         3  GU.PR.         X        X    ? LAB
    7         3  TEST           X        X    ? LAB
DO YOU WISH TO SEE THE ASSIGNMENT (Y/N)? N
**********************************
**** IDENTIFYING MEDIA ****
WOULD YOU LIKE TO SEE THE CODES FOR MEDIA RESOURCES (Y/N)? Y
--------CODES FOR MEDIA RESOURCES--------
REFER TO VIII G, VIII G 1, 2, WORKSHEET V)
A - AUDIO
SV - STILL VISUAL (INCLUDES BOOKS, WORKBOOKS, ETC.)
MV - MOTION VISUAL
AMV - AUDIO-MOTION VISUAL
ASV - AUDIO-STILL VISUAL
AT - AUDIO WITH TYPE
T - TELETYPE
```

Fig. 15—Continued (page 6 of 7)

```
**********************************************
**** IDENTIFYING INSTRUCTOR SUPPORT MEDIA **** (REFER TO VIII G 1 B)
ASSIGN RESOURCE BY (W, B, SM, LET, T, SMLE, SMGT, SMLS, LE, N)? LET
PLEASE ENTER THE RESOURCE FOR EACH LEARNING EVENT TYPE
LEARNING
EVENT
TYPE          RESOURCE
------------ --------
PRESENTATION ?  I.SV
GUID. PRACT. ?
UNGU. PRACT. ?
DISCUSSION   ?  I.SV
REVIEW       ?  I.SV
CRITIQUE     ?

DO YOU WISH TO SEE THE ASSIGNMENT (Y/N)? N
**********************************************
**** IDENTIFYING LEARNER SUPPORT MEDIA **** (REFER TO VIII G 1 A)
ASSIGN RESOURCE BY (W, B, SM, LET, T, SMLE, SMGT, SMLS, LE, N)? SMLS
PLEASE NAME THE RESOURCE FOR EACH SUBJ. MATTER TYPE
LEARNING EVENT TYPE, AND TRACK
SUBJECT          LEARNING
MATTER           EVENT     SL SL FS FS
TYPE      TRACK  TYPE      NE E  NE E   RESOURCE
-------   -----  --------  -- -- -- --  --------
    1         1  HMWK.     X              ? L.ASV
    1         2  HMWK.        X           ? L.SV
    1         3  HMWK.     X     X        ? L.SV
    2         1  HMWK.     X              ? L.ASV
    2         2  HMWK.        X           ? L.SV
    2         3  HMWK.     X     X        ? L.SV
    6         1  HMWK.     X              ? L.ASV
    6         1  TEST      X              ? L.SV
    6         2  GU.PR.       X           ? L.SV
    6         2  UNG.P.       X           ?
    6         2  HMWK.        X           ? L.SV
    6         2  TEST         X           ? L.SV
    6         3  GU.PR.    X     X        ? L.SV
    6         3  UNG.P.    X     X        ?
    6         3  HMWK.     X     X        ? L.SV
    6         3  TEST      X     X        ? L.SV
    7         1  GU.PR.    X              ? L.SV
    7         1  TEST      X              ? L.SV
    7         2  GU.PR.       X           ? L.SV
    7         2  TEST         X           ? L.SV
    7         3  GU.PR.    X     X        ? L.SV
    7         3  TEST      X     X        ? L.SV
DO YOU WISH TO SEE THE ASSIGNMENT (Y/N)? N
**********************************************
**** IDENTIFYING PROGRAM MEDIA **** (REFER TO VIII G 1 C)
ASSIGN RESOURCE BY (W, B, SM, LET, T, SMLE, SMGT, SMLS, LE, N)? W
PLEASE NAME THE RESOURCE? P.SV
DO YOU WISH TO SEE THE ASSIGNMENT (Y/N)? N
**********************************************
**** IDENTIFYING RECORDING HARDWARE **** (REFER TO VIII H)
ASSIGN RESOURCE BY (LET, SMLE, LE, N)?                              N
```

Fig. 15—Continued (page 7 of 7)

**** FINAL LIST OF LEARNING EVENTS ****

L.E. NUM	NAME	SUBJ MATR	L. E. TYPE	TCHG FORM	TCHG AGENT	SLOW NO-E	SLOW E.E.	FAST NO-E	FAST E.E.	ANURN 5	TSNR1	TSNR2	SIGGEN	INSTRCTR	EVALUATR	INSTRCTR (AS MON)	LAB.MON	ROOM 1	LAB	I.SV	L.ASV	L.SV
					TRACK 1																	
1	TESTEQP.	1	P	R	I	X								✓				✓		✓		
2			HW	RF	L	X															✓	
3	TESTEQP.	2	P	R	I	X								✓				✓		✓		
4			HW	RF	L	X															✓	
5	URN5CHAR	2	P	R	I	X								✓				✓		✓		
6			HW	RF	L	X															✓	
7	URN5CHAR	6	GP	R	I	X								✓				✓				
8			UP	R	I	X								✓				✓				
9			D	G	I	X								✓				✓		✓		
10			HW	RF	L	X															✓	
11	SERVROUT	7	GP	S	L	X				✓	✓	✓	✓				✓		✓			✓
12	URN5CHAR	6	GP	R	I	X								✓				✓				
13			UP	R	I	X								✓				✓				
14			D	G	I	X								✓				✓		✓		
15			HW	RF	L	X															✓	
16	SERVROUT	7	GP	S	L	X				✓	✓	✓	✓				✓		✓			✓
17	TBSHPRIN	1	P	R	I	X								✓				✓		✓		
18			HW	RF	L	X															✓	
19	TBSHPRIN	2	P	R	I	X								✓				✓		✓	✓	
20			HW	RF	L	X															✓	
21	TBSHURN5	7	GP	S	L	X				✓	✓	✓	✓				✓		✓			✓
22	FLTCHK..	1	P	R	I	X								✓				✓		✓		
23			HW	RF	L	X															✓	
24	INSTALL.	1	P	R	I	X								✓				✓		✓		
25			HW	RF	L	X															✓	
26	REVUE1..	6	R	R	I	X								✓				✓		✓		
27	EXAM1...	6	T	S	L	X										✓		✓				✓
28	EXAM1...	7	T	S	L	X				✓	✓	✓	✓		✓				✓			✓
29	CRITQ1..	1	C	G	I	X								✓	✓			✓				

Fig. 16—Use of "Final List of Learning Events" (partial) as worksheet for assigning resources to learning events

are entered. This feature allows greater flexibility in manipulating resource assignments, as is discussed below.

When the user indicates that he is satisfied with the assignment, he begins assigning non-special resources. Allocations may be made learning event by learning event or by combinations of learning events. All of the combinations available are shown on the code card. The program refers to these as "Resource Assignment Policies," as shown on page 3 of Fig. 15, and displays acceptable policies for each resource type. Figure 15 illustrates the use of several of these policies.

The resource assignment policies can relieve the drudgery of assigning resources learning event by learning event and should be used whenever possible. Even if none of these policies exactly matches the assignment the user wants to make, it is better to use one that very nearly matches than to assign learning event by learning event, if many learning events are involved. As mentioned in the overview of this phase, the user may adjust the resulting assignment at the end of Phase 6.

The assignment processes for several of the resource types have special features. For example, the program assigns instructor types only to learning events for which the teaching agent is an instructor. The effect of this is illustrated in Fig. 17, the "Total Resource Assignment Report" produced at the end of this phase; note, for example, that most of the learning events for tracks 2 and 3 (pages 2 through 5 of Fig. 17) do not have an instructor assigned, even though "Instrctr" was assigned to the whole course, because the teaching agent for these events is the learner or an adaptive program.

Evaluators are assigned to all check practice, test, and critique events unless the user includes "learning event type" in his resource assignment policy and deletes evaluators for one or more of these types. An example of this feature is shown in Fig. 15, pages 3 and 4.

The UI assigns monitors to all learning events in which the teaching agent is not an instructor and to all learning events with subject matter types 7, 8, 9, or 10. The effects of these rules are illustrated in Fig. 15, pages 4 and 5. Note that in our example we named the monitor "instrctr" for subject matter type 6, track 1, test events. This makes the same instructor who teaches track 1 (designated "instrctr" in the assignment of instructors to the course) a monitor for these events. Note also that the UI display of the resulting assignment of monitors includes all of the events in which the "instrctr" is a teaching agent. This is because designation of a monitor as "instrctr" causes the UI to retrieve all instances in which "instrctr" has been assigned to learning events in order to generate this report.

There are no special rules for assignment of facilities.

It is not mandatory to use the codes for identifying classes of communication media displayed on page 6 of Fig. 15. These, described in *Options for Course Design*, Sec. VII.G, are provided merely for convenient reference.

Media are assigned to support each teaching agent in turn—instructors, learners, and programs (adaptive or response-paced). Thus, the UI assigns instructor support media only to learning events for which instructors are teaching agents, learner support media where learners are teaching agents, and program support media where programs are teaching agents. The assignment process is illustrated on page 7 of Fig. 15. The results of the assignment are shown in Fig. 17. Note that we have prefixed instructor-support media with "I," learner-support media with

```
**********************************************
**** TOTAL RESOURCE ASSIGNMENT REPORT ****
 -------LEARNING EVENTS-------  STUD.CAT.-  -RESOURCES-
L.E          S M L.E TCHG TCHG   SL SL FS FS
NUM NAME     TYP TYP FORM AGENT  NE E  NE E     NAME
--- ----     --- --- ---- -----  -- -- -- --     ----
---------------  TRACK 1  ---------------
  1 TESTEQP. 1   P   R     I     X              INSTRCTR
                                                ROOM1
                                                I.SV
  2 TESTEQP. 1   HW  RF    L     X              L.ASV
  3 TESTEQP. 2   P   R     I     X              INSTRCTR
                                                ROOM1
                                                I.SV
  4 TESTEQP. 2   HW  RF    L     X              L.ASV
  5 URN5CHAR 2   P   R     I     X              INSTRCTR
                                                ROOM1
                                                I.SV
  6 URN5CHAR 2   HW  RF    L     X              L.ASV
  7 URN5CHAR 6   GP  R     I     X              INSTRCTR
                                                ROOM1
  8 URN5CHAR 6   UP  R     I     X              INSTRCTR
                                                ROOM1
  9 URN5CHAR 6   D   G     I     X              INSTRCTR
                                                ROOM1
                                                I.SV
 10 URN5CHAR 6   HW  RF    L     X              L.ASV
 11 SERVROUT 7   GP  S     L     X              ANURN5
                                                TSNR1
                                                TSNR2
                                                SIGGEN
                                                LAB.MON
                                                LAB
                                                L.SV
 12 URN5CHAR 6   GP  R     I     X              INSTRCTR
                                                ROOM1
 13 URN5CHAR 6   UP  R     I     X              INSTRCTR
                                                ROOM1
 14 URN5CHAR 6   D   G     I     X              INSTRCTR
                                                ROOM1
                                                I.SV
 15 URN5CHAR 6   HW  RF    L     X              L.ASV
 16 SERVROUT 7   GP  S     L     X              ANURN5
                                                TSNR1
                                                TSNR2
                                                SIGGEN
                                                LAB.MON
                                                LAB
                                                L.SV
 17 TBSHPRIN 1   P   R     I     X              INSTRCTR
                                                ROOM1
                                                I.SV
 18 TBSHPRIN 1   HW  RF    L     X              L.ASV
 19 TBSHPRIN 2   P   R     I     X              INSTRCTR
                                                ROOM1
                                                I.SV
```

Fig. 17—Total resource assignment report (page 1 of 5)

20	TBSHPRIN	2	HW	RF	L	X	L.ASV
21	TBSHURN5	7	GP	S	L	X	ANURN5
							TSNR1
							TSNR2
							SIGGEN
							LAB.MON
							LAB
							L.SV
22	FLTCHK..	1	P	R	I	X	INSTRCTR
							ROOM1
							I.SV
23	FLTCHK..	1	HW	RF	L	X	L.ASV
24	INSTALL.	1	P	R	I	X	INSTRCTR
							ROOM1
							I.SV
25	INSTALL.	1	HW	RF	L	X	L.ASV
26	REVUE1..	6	R	R	I	X	INSTRCTR
							ROOM1
							I.SV
27	EXAM1...	6	T	S	L	X	INSTRCTR
							ROOM1
							L.SV
28	EXAM1...	7	T	S	L	X	ANURN5
							TSNR1
							TSNR2
							SIGGEN
							EVALUATR
							LAB
							L.SV
29	CRITQ1..	1	C	G	I	X	INSTRCTR
							EVALUATR
							ROOM1
----------		TRACK 2					----------
30	TESTEQP.	1	P	AF	AP	X	RM2.MON
							ROOM2
							P.SV
31	TESTEQP.	1	HW	AF	L	X	L.SV
32	TESTEQP.	2	P	AF	AP	X	RM2.MON
							ROOM2
							P.SV
33	TESTEQP.	2	HW	AF	L	X	L.SV
34	URN5CHAR	2	P	AF	AP	X	RM2.MON
							ROOM2
							P.SV
35	URN5CHAR	2	HW	AF	L	X	L.SV
36	URN5CHAR	6	GP	AF	L	X	RM2.MON
							ROOM2
							L.SV
37	URN5CHAR	6	UP	S	L	X	RM2.MON
							ROOM2
38	URN5CHAR	6	D	G	I	X	INSTRCTR
							ROOM2
							I.SV
39	URN5CHAR	6	HW	S	L	X	L.SV
40	SERVROUT	7	GP	S	L	X	ANURN5
							TSNR1
							TSNR2
							SIGGEN
							LAB.MON
							LAB
							L.SV

Fig. 17—Continued (page 2 of 5)

41 URN5CHAR	6	GP	AF	L	X	RM2.MON ROOM2 L.SV
42 URN5CHAR	6	UP	S	L	X	RM2.MON ROOM2
43 URN5CHAR	6	D	G	I	X	INSTRCTR ROOM2 I.SV
44 URN5CHAR	6	HW	S	L	X	L.SV
45 SERVROUT	7	GP	S	L	X	ANURN5 TSNR1 TSNR2 SIGGEN LAB.MON LAB L.SV
46 TBSHPRIN	1	P	AF	AP	X	RM2.MON ROOM2 P.SV
47 TBSHPRIN	1	HW	AF	L	X	L.SV
48 TBSHPRIN	2	P	AF	AP	X	RM2.MON ROOM2 P.SV
49 TBSHPRIN	2	HW	AF	L	X	L.SV
50 TBSHURN5	7	GP	S	L	X	ANURN5 TSNR1 TSNR2 SIGGEN LAB.MON LAB L.SV
51 FLTCHK..	1	P	AF	AP	X	RM2.MON ROOM2 P.SV
52 FLTCHK..	1	HW	AF	L	X	L.SV
53 INSTALL.	1	P	AF	AP	X	RM2.MON ROOM2 P.SV
54 INSTALL.	1	HW	AF	L	X	L.SV
55 EXAM1...	6	T	S	L	X	RM2.MON ROOM2 L.SV
56 EXAM1...	7	T	S	L	X	ANURN5 TSNR1 TSNR2 SIGGEN EVALUATR LAB L.SV
57 CRITQ1..	1	C	G	I	X	INSTRCTR EVALUATR ROOM2

Fig. 17—Continued (page 3 of 5)

TRACK 3						
58 TESTEQP. 2	P	AF	AP	X		RM3.MON
						ROOM3
						P.SV
59 TESTEQP. 2	HW	AF	L	X		L.SV
60 URN5CHAR 2	P	AF	AP	X	X	RM3.MON
						ROOM3
						P.SV
61 URN5CHAR 2	HW	AF	L	X	X	L.SV
62 URN5CHAR 6	GP	AF	L	X	X	RM3.MON
						ROOM3
						L.SV
63 URN5CHAR 6	UP	S	L	X	X	RM3.MON
						ROOM3
64 URN5CHAR 6	D	G	I	X	X	INSTRCTR
						ROOM3
						I.SV
65 URN5CHAR 6	HW	S	L	X	X	L.SV
66 SERVROUT 7	GP	S	L	X	X	ANURN5
						TSNR1
						TSNR2
						SIGGEN
						LAB.MON
						LAB
						L.SV
67 URN5CHAR 6	GP	AF	L	X	X	RM3.MON
						ROOM3
						L.SV
68 URN5CHAR 6	UP	S	L	X	X	RM3.MON
						ROOM3
69 URN5CHAR 6	D	G	I	X	X	INSTRCTR
						ROOM3
						I.SV
70 URN5CHAR 6	HW	S	L	X	X	L.SV
71 SERVROUT 7	GP	S	L	X	X	ANURN5
						TSNR1
						TSNR2
						SIGGEN
						LAB.MON
						LAB
						L.SV
72 TBSHPRIN 1	P	AF	AP	X	X	RM3.MON
						ROOM3
						P.SV
73 TBSHPRIN 1	HW	AF	L	X	X	L.SV
74 TBSHPRIN 2	P	AF	AP	X	X	RM3.MON
						ROOM3
						P.SV
75 TBSHPRIN 2	HW	AF	L	X	X	L.SV

Fig. 17—Continued (page 4 of 5)

```
76 TBSHURN5 7   GP  S     L       X      X  ANURN5
                                             TSNR1
                                             TSNR2
                                             SIGGEN
                                             LAB.MON
                                             LAB
                                             L.SV
77 FLTCHK.. 1   P   AF    AP      X      X  RM3.MON
                                             ROOM3
                                             P.SV
78 FLTCHK.. 1   HW  AF    L       X      X  L.SV
79 INSTALL. 1   P   AF    AP      X      X  RM3.MON
                                             ROOM3
                                             P.SV
80 INSTALL. 1   HW  AF    L       X      X  L.SV
81 REVUE1.. 6   R   G     I       X         INSTRCTR
                                             ROOM3
                                             I.SV
82 EXAM1... 6   T   S     L       X      X  RM3.MON
                                             ROOM3
                                             L.SV
83 EXAM1... 7   T   S     L       X      X  ANURN5
                                             TSNR1
                                             TSNR2
                                             SIGGEN
                                             EVALUATR
                                             LAB
                                             L.SV
84 CRITQ1.. 1   C   G     I       X      X  INSTRCTR
                                             EVALUATR
                                             ROOM3
DO YOU WISH TO CHANGE THE ASSIGNMENT (Y/N)? N
```

Fig. 17—Continued (page 5 of 5)

"L," and program-support media with "P." This is not required, but is of great help in reading the "Summary of Media Usage" produced in the next phase, *Describe Resource Constraints.*

The L.SV media (still visual media supporting the learner) usually represent printed materials of various kinds and need not be entered in the UI because MODCOM can compute the number required, assuming that each student is given a copy of all printed materials prepared for the course. We entered the L.SV media in the example primarily to illustrate the program interaction and to show how including them in the "Summary of Media Usage" can help in preparing MODCOM input. Media systems requiring expensive hardware (e.g., P.SV—still visual media supporting an automated program—in our example) should always be entered so that the RUM can compute the number of items required and the utilization.

There are no special rules for assignment of recording hardware.

Once all of the resources have been assigned, the UI summarizes the assignments in a "Total Resource Assignment Report," shown in Fig. 17, which the user should double space. After this report has been displayed, the user may change the assignment by adding or deleting resources in the list to or from any learning event or by adding resources not in the list. When he is satisfied with the assignment, the phase is complete. The "Total Resource Assignment Report" should be saved for the next phase.

DESCRIBE RESOURCE CONSTRAINTS (AND FINISH COURSE DESIGN)—PHASE 7

Overview

In this phase the user specifies characteristics of each resource entered in the course design, defines the maximum and minimum number of students that may form a section of each learning event, enters the average time required for each learning event, and indicates how much longer than the average and less than the average a student may remain in the event. The UI then produces several reports that summarize the course design. Fig. 18 shows how the "Total Resource Assignment Report" should be used as a worksheet for this phase.

Discussion

The specification of resource characteristics follows the same process for all resources, as illustrated in Fig. 19. Note that ? may be entered in response to questions on capacity or availability to cause the RUM to estimate the capacity or number needed. This is the only instance in which a non-numeric response may be made to a question calling for a numerical answer. After a particular resource has been described, the user may revise his entries for that resource in case an incorrect entry has been made inadvertently.

Once the characteristics of all resources have been entered, the user may ask the UI to summarize the information in the "Summary of Resource Constraints" shown in Fig. 20. The last column of this report indicates the maximum number of students that each resource can support simultaneously for each learning event and should be considered in the next step in which section size is specified. If this maximum is unknown (UNK), the user may enter whatever section size he wishes.

The UI asks the user next to specify the maximum and minimum section sizes, average time, and maximum and minimum times allowed for each learning event. These specifications may be made learning event by learning event or by using the combinations of learning events from the preceding phase and referred to as "Resource Assignment Policies." As before, it is better to make these assignments with as few entries as possible, although often average time must be assigned learning event by learning event. Figure 21 shows an example of using the combination of subject matter type, learning event type, and student track (SMLS) to assign maximum section size. Note that 38 entries suffice rather than the 84 that would be required to make this assignment learning event by learning event.

Entry of the maximum and minimum time a student may spend in a learning event (not illustrated) merits some discussion. First, these entries are made in terms of relative factors—that is, numbers that will be multiplied by the average time to obtain the maximum and minimum number of minutes. For example, if the average time for the event is 30 minutes, and the student may stay in the event for no more than 45 minutes and no less than 15 minutes, the maximum relative time factor would be 1.5 and the minimum .5. (This is the only instance where fractions may be entered in response to a question calling for a numerical answer.)

Second, if the maximum section size is greater than 1, the relative time factors have no effect—all students take the average time entered for the learning event. Therefore, if all maximum section sizes are greater than 1, it is simplest to enter

**** TOTAL RESOURCE ASSIGNMENT REPORT ****

L.E NUM	L.E NAME	LEARNING EVENTS: S M TYP	L.E TYP	TCHG FORM	TCHG AGENT	STUD.CAT.: SL NE	SL E	FS NE	FS E
		TRACK 1							
1	TESTEQP.		P	R	I	X			
2	TESTEQP. 1		HW	RF	L	X			
3	TESTEQP. 2		P	R	I	X			
4	TESTEQP. 2		HW	RF	L	X			
5	URN5CHAR 2		P	R	I	X			
6	URN5CHAR 2		HW	RF	L	X			
7	URN5CHAR 6		GP	R	I	X			
8	URN5CHAR 6		UP	R	I	X			
9	URN5CHAR 6		D	G	I	X			
10	URN5CHAR 6		HW	RF	L	X			
11	SERVROUT 7		GP	S	L	X			
12	URN5CHAR 6		GP	R	I	X			
13	URN5CHAR 6		UP	R	I	X			
14	URN5CHAR 6		D	G	I	X			
15	URN5CHAR 6		HW	RF	L	X			
16	SERVROUT 7		GP	S	L	X			
17	TBSHPRIN 1		P	R	I	X			
18	TBSHPRIN 1		HW	RF	L	X			
19	TBSHPRIN 2		P	R	I	X			

-RESOURCES- NAME	RESOURCE CONSTRAINTS: NR. AVAIL[a]	CAPACITY[b]	SHARED[b]	SIZE AND TIME: MAX SIZE[b]	MIN SIZE[b]	AV. TIME[b]	MAX TIME[b]	MIN TIME[b]
INSTRCTR	3	6	N	6	2	90	(1)	(1)
ROOM1	3	(6)	N					
L.SV	3	(6)	(N)					
L.ASV	1	(6)	(N)	1	1	30		
INSTRCTR		6	N					
ROOM1			N	6	2	60		
L.SV								
L.ASV				1	1	30		
INSTRCTR		6	N					
ROOM1			N	6	2	120		
L.SV								
L.ASV				1	1	30		
INSTRCTR		4	N					
ROOM1			N	6	2	110		
INSTRCTR		6	N					
ROOM1			N	6	2	220		
INSTRCTR		6	N					
ROOM1			N	6	2	30		
L.SV								
L.ASV				1	1	60		
ANURN5	8	(6)	(N)					
TSNR1	8	(6)	(N)					
TSNR2	8	(6)	(N)					
SIGGEN	8	(6)	(N)	8	2	50		
LAB.MON	1	(6)	(N)					
LAB	1	(6)	(N)					
L.SV	34	(6)	(N)					
INSTRCTR		4	N					
ROOM1			N	6	2	110		
INSTRCTR		6	N					
ROOM1			N	6	2	220		
INSTRCTR		6	N					
ROOM1			N	6	2	30		
L.SV								
L.ASV				1	1	60		
ANURN5								
TSNR1								
TSNR2								
SIGGEN				8	2	90		
LAB.MON								
LAB								
L.SV								
INSTRCTR		6	N					
ROOM1			N	6	2	30		
L.SV								
L.ASV				1	1	15		
INSTRCTR		6	N					
ROOM1			N	6	2	60		
L.SV								

[a]Enter first time resource appears, only.

[b]Enter only once and circle if item does not vary.

Fig. 18—Use of "Total Resource Assignment Report" as worksheet for describing resource constraints and specifying section size and time

```
*****************************************
**** IDENTIFYING RESOURCE CONSTRAINTS ****
      FOR                    REFER TO
SPECIAL RESOURCES             IX A
INSTRUCTORS                   IX B
EVALUATORS                    IX C
MONITORS                      IX D
FACILITIES                    IX E
MEDIA                         IX F
RECORDING HARDWARE            IX G
IN THE FOLLOWING SET OF QUESTIONS ON RESOURCE CONSTRAINTS PLEASE
INDICATE THAT THE CAPACITY OR QUANTITY OF ANY RESOURCE IS UNKNOWN BY
RESPONDING WITH A QUESTION MARK (?).
-----ANURN5
WHAT IS THE USUAL CAPACITY ? 2
DOES THE CAPACITY VARY (Y/N)? N
HOW MANY WILL BE AVAILABLE ? 4
CAN IT BE SHARED (Y/N)? N
DO YOU WISH TO CHANGE THIS ASSIGNMENT (Y/N)? N
 .
 .
 .
-----INSTRCTR
WHAT IS THE USUAL CAPACITY ? 6
DOES THE CAPACITY VARY (Y/N)? Y
PLEASE IDENTIFY EACH UNUSUAL L. E. AND THE ASSOCIATED CAPACITY
L. E.   CAPACITY
-----   --------
? 7       4
? 12      4
? 27      16
?
HOW MANY WILL BE AVAILABLE ? 2
CAN IT BE SHARED (Y/N)? Y
CAN ALL LEARNING EVENTS SHARE IT (Y/N)? N
PLEASE LIST THE LEARNING EVENTS WHICH SHARE IT
? 27
?
DO YOU WISH TO CHANGE THIS ASSIGNMENT (Y/N)? N
 .
 .
 .
-----RM2.MON
WHAT IS THE USUAL CAPACITY ? 12
DOES THE CAPACITY VARY (Y/N)? N
HOW MANY WILL BE AVAILABLE ? 1
CAN IT BE SHARED (Y/N)? Y
CAN ALL LEARNING EVENTS SHARE IT (Y/N)? Y
DO YOU WISH TO CHANGE THIS ASSIGNMENT (Y/N)? N
 .
 .
 .
-----ROOM1
WHAT IS THE USUAL CAPACITY ? 6
DOES THE CAPACITY VARY (Y/N)? N
HOW MANY WILL BE AVAILABLE ? 2
CAN IT BE SHARED (Y/N)? Y
CAN ALL LEARNING EVENTS SHARE IT (Y/N)? N
PLEASE LIST THE LEARNING EVENTS WHICH SHARE IT
? 13
? 27
?
DO YOU WISH TO CHANGE THIS ASSIGNMENT (Y/N)? 1
```

Fig. 19—Describe resource constraints (partial)

```
DO YOU WISH TO SEE THE SUMMARY OF RESOURCE CONSTRAINTS (Y/N)? Y
*****************************************
**** SUMMARY OF RESOURCE CONSTRAINTS ****
 -------LEARNING EVENTS-------  STUD.CAT.-  -------RESOURCES-------
L.E                    S M L.E TCHG TCHG   SL SL FS FS                    INDIV  TOTAL
NUM NAME               TYP TYP FORM AGENT  NE E  NE E   NAME     AVL     CAP    CAP
--- ----               --- --- ---- -----  -- -- -- --  ------   ----    -----  -----
---------------   TRACK 1   ---------------
  1 TESTEQP. 1         P   R    I      X          INSTRCTR 2       6      12
                                                 ROOM1    2       6      12
                                                 I.SV     2       6      12
  2 TESTEQP. 1         HW  RF   L      X          L.ASV    UNK     1      UNK
  3 TESTEQP. 2         P   R    I      X          INSTRCTR 2       6      12
                                                 ROOM1    2       6      12
                                                 I.SV     2       6      12
  4 TESTEQP. 2         HW  RF   L      X          L.ASV    UNK     1      UNK
  5 URN5CHAR 2         P   R    I      X          INSTRCTR 2       6      12
                                                 ROOM1    2       6      12
                                                 I.SV     2       6      12
  6 URN5CHAR 2         HW  RF   L      X          L.ASV    UNK     1      UNK
  7 URN5CHAR 6         GP  R    I      X          INSTRCTR 2       4      8
                                                 ROOM1    2       6      12
  8 URN5CHAR 6         UP  R    I      X          INSTRCTR 2       6      12
                                                 ROOM1    2       6      12
  9 URN5CHAR 6         D   G    I      X          INSTRCTR 2       6      12
                                                 ROOM1    2       6      12
                                                 I.SV     2       6      12
 10 URN5CHAR 6         HW  RF   L      X          L.ASV    UNK     1      UNK
 11 SERVROUT 7         GP  S    L      X          ANURN5   4       2      8
                                                 TSNR1    4       2      8
                                                 TSNR2    4       2      8
                                                 SIGGEN   4       2      8
                                                 LAB.MON  2       6      12
                                                 LAB      1       20     20
                                                 L.SV     34      1      34
 12 URN5CHAR 6         GP  R    I      X          INSTRCTR 2       4      8
                                                 ROOM1    2       6      12
 13 URN5CHAR 6         UP  R    I      X          INSTRCTR 2       6      12
                                                 ROOM1    2       6      12
 14 URN5CHAR 6         D   G    I      X          INSTRCTR 2       6      12
                                                 ROOM1    2       6      12
                                                 I.SV     2       6      12
```

Fig. 20—Summary of resource constraints (partial)

1 for both time factors for the whole course. If some (but not all) learning events have maximum sizes of 1, enter the relative time factors that apply to those learning events in the most efficient way possible, ignoring the learning events with section sizes greater than 1. Whatever factors are assigned to the latter events have no effect in the RUM.

After the time factors have been entered, the UI produces a report on "Complete Time and Section Size Assignment" for all learning events as illustrated in Fig. 22. At the end of this report, the user may change any of the entries he wishes. Thus, minor discrepancies caused by use of a particular resource assignment policy can be corrected at this point.

Corrections are made in two stages—one for revising maximum or minimum section size (MXS, MIS) or average time (AT) and one for the time multipliers,

```
**********************************************
**** IDENTIFYING MAXIMUM SECTION SIZE **** (REFER TO X A 1)
**** ASSIGNMENTS MUST BE MADE FOR ALL LEARNING EVENTS ****
ASSIGN QUANTITY BY (W, B, SM, LET, T, SMLE, SMGT, SMLS, LE)?    SMLS
PLEASE INDICATE THE QUANTITY FOR EACH SUBJ. MATTER TYPE
LEARNING EVENT TYPE, AND TRACK
SUBJECT          LEARNING
MATTER           EVENT      SL SL FS FS
TYPE      TRACK  TYPE       NE E  NE E   QUANTITY
-------   -----  --------   -- -- -- --  --------
    1         1  PRES.      X                ? 6
    1         1  HMWK.      X                ? 1
    1         1  CRITQ.     X                ? 6
    1         2  PRES.            X         ? 6
    1         2  HMWK.            X         ? 1
    1         2  CRITQ.           X         ? 6
    1         3  PRES.         X     X      ? 1
    1         3  HMWK.         X     X      ? 1
    1         3  CRITQ.        X     X      ? 6
    2         1  PRES.      X                ? 6
    2         1  HMWK.      X                ? 1
    2         2  PRES.            X         ? 1
    2         2  HMWK.            X         ? 1
    2         3  PRES.         X     X      ? 1
    2         3  HMWK.         X     X      ? 1
    6         1  GU.PR.     X                ? 6
    6         1  UNG.P.     X                ? 6
    6         1  DISC.      X                ? 6
    6         1  HMWK.      X                ? 1
    6         1  REVIEW     X                ? 6
    6         1  TEST       X                ? 6
    6         2  GU.PR.           X         ? 1
    6         2  UNG.P.           X         ? 1
    6         2  DISC.            X         ? 6
    6         2  HMWK.            X         ? 1
    6         2  TEST             X         ? 1
    6         3  GU.PR.        X     X      ? 1
    6         3  UNG.P.        X     X      ? 1
    6         3  DISC.         X     X      ? 6
    6         3  HMWK.         X     X      ? 1
    6         3  REVIEW        X     X      ? 6
    6         3  TEST          X     X      ? 1
    7         1  GU.PR.     X                ? 8
    7         1  TEST       X                ? 8
    7         2  GU.PR.           X         ? 8
    7         2  TEST             X         ? 8
    7         3  GU.PR.        X     X      ? 8
    7         3  TEST          X     X      ? 8
DO YOU WISH TO SEE THE ASSIGNMENT (Y/N)? N
```

Fig. 21—Describe section size and time (partial)

```
DO YOU WISH TO SEE THE ASSIGNMENT (Y/N)? N
**************************************************
**** COMPLETE TIME AND SECTION SIZE ASSIGNMENT ****
 -------LEARNING EVENTS-------  STUD.CAT.- -----QUANTITIES----
L.E                S M L.E TCHG TCHG  SL SL FS FS  MAX MIN AVG MAX MIN
NUM NAME           TYP TYP FORM AGENT NE E  NE E   SZ  SZ  TIM TIM TIM
--- ----           --- --- ---- ----- -- -- -- --  --- --- --- --- ---
---------------    TRACK 1   ---------------
  1 TESTEQP. 1     P   R    I     X                6   2   90  1.  1.
  2 TESTEQP. 1     HW  RF   L     X                1   1   20  1.  1.
  3 TESTEQP. 2     P   R    I     X                6   2   60  1.  1.
  4 TESTEQP. 2     HW  RF   L     X                1   1   20  1.  1.
  5 URN5CHAR 2     P   R    I     X                6   2   120 1.  1.
  6 URN5CHAR 2     HW  RF   L     X                1   1   20  1.  1.
  7 URN5CHAR 6     GP  R    I     X                6   2   110 1.  1.
  8 URN5CHAR 6     UP  R    I     X                6   2   220 1.  1.
  9 URN5CHAR 6     D   G    I     X                6   2   30  1.  1.
 10 URN5CHAR 6     HW  RF   L     X                1   1   60  1.  1.
 11 SERVROUT 7     GP  S    L     X                8   2   30  1.  1.
 12 URN5CHAR 6     GP  R    I     X                6   2   110 1.  1.
 13 URN5CHAR 6     UP  R    I     X                6   2   220 1.  1.
 14 URN5CHAR 6     D   G    I     X                6   2   30  1.  1.
 15 URN5CHAR 6     HW  RF   L     X                1   1   60  1.  1.
 16 SERVROUT 7     GP  S    L     X                8   2   90  1.  1.
 17 TBSHPRIN 1     P   R    I     X                6   2   30  1.  1.
 18 TBSHPRIN 1     HW  RF   L     X                1   1   15  1.  1.
 19 TBSHPRIN 2     P   R    I     X                6   2   60  1.  1.
 20 TBSHPRIN 2     HW  RF   L     X                1   1   15  1.  1.
 21 TBSHURN5 7     GP  S    L     X                8   2   90  1.  1.
 22 FLTCHK.. 1     P   R    I     X                6   2   30  1.  1.
 23 FLTCHK.. 1     HW  RF   L     X                1   1   15  1.  1.
 24 INSTALL. 1     P   R    I     X                6   2   30  1.  1.
 25 INSTALL. 1     HW  RF   L     X                1   1   15  1.  1.
 26 REVUE1.. 6     R   R    I     X                6   2   30  1.  1.
 27 EXAM1... 6     T   S    L     X                6   2   30  1.  1.
 28 EXAM1... 7     T   S    L     X                8   2   30  1.  1.
 29 CRITQ1.. 1     C   G    I     X                6   2   15  1.  1.
  .
  .
  .
 78 FLTCHK.. 1     HW  AF   L        X     X     1   1   15  1.  1.
 79 INSTALL. 1     P   AF   AP       X     X     1   1   23  1.  1.
 80 INSTALL. 1     HW  AF   L        X     X     1   1   15  1.  1.
 81 REVUE1.. 6     R   G    I        X           6   2   30  1.  1.
 82 EXAM1... 6     T   S    L        X     X     1   1   30  1.  1.
 83 EXAM1... 7     T   S    L        X     X     8   2   30  1.  1.
 84 CRITQ1.. 1     C   G    I        X     X     6   2   15  1.  1.
DO YOU WISH TO CHANGE MXS, MIS, OR AT ASSIGNMENT (Y/N)? Y
WHICH QUANTITY IS TO BE CHANGED (MXS, MIS, AT)? MXS
PLEASE ENTER NEW INTEGER QUANTITY
L.E.   QUANTITY
----   --------
? 30       1
? 46       1
? 51       1
? 53       1
?
DO YOU WISH TO CHANGE MXS, MIS, OR AT ASSIGNMENT (Y/N)? N
DO YOU WISH TO CHANGE THE MXT OR MIT QUANTITY (Y/N)? N
```

Fig. 22—Complete time and section size (partial)

maximum time or minimum time (MXT or MIT). This is required because non-integer values for MXT or MIT cannot be entered in the more efficient format used for revising MXS, MIS, or AT.

At the end of this phase, the user may have the UI produce several reports that summarize features of the course. The most extensive of these is the "Summary of Course Design," an example of which is shown in Fig. 23. This displays the learning events, the teaching method assigned to each, the categories of students taking each, the section size and time descriptions, and the resources assigned. The next report summarizes the characteristics of the resources as specified by the user, shown in Fig. 24. Figure 25 (not optional) shows the "Summary of Course Minutes and Equivalent Days" for both classroom instruction and homework for each stu-

```
DO YOU WISH TO SEE THE SUMMARY OF COURSE DESIGN (Y/N)? Y
**********************************
**** SUMMARY OF COURSE DESIGN ****
 -------LEARNING EVENTS-------  STUD.CAT.- -----QUANTITIES---- RESOURCES
L.E          S M L.E TCHG TCHG  SL SL FS FS  MAX MIN AVG MAX MIN
NUM NAME     TYP TYP FORM AGENT NE E  NE E   SZ  SZ  TIM TIM TIM
--- ----     --- --- ---- ----- -- -- -- --  --- --- --- --- ---
---------------   TRACK 1   ---------------
  1 TESTEQP. 1   P   R    I     X           6   2   90  1.  1.  INSTRCTR
                                                                ROOM1
                                                                I.SV
  2 TESTEQP. 1   HW  RF   L     X           1   1   20  1.  1.  L.ASV
  3 TESTEQP. 2   P   R    I     X           6   2   60  1.  1.  INSTRCTR
                                                                ROOM1
                                                                I.SV
  4 TESTEQP. 2   HW  RF   L     X           1   1   20  1.  1.  L.ASV
  5 URN5CHAR 2   P   R    I     X           6   2   120 1.  1.  INSTRCTR
                                                                ROOM1
                                                                I.SV
  6 URN5CHAR 2   HW  RF   L     X           1   1   20  1.  1.  L.ASV
  7 URN5CHAR 6   GP  R    I     X           6   2   110 1.  1.  INSTRCTR
                                                                ROOM1
  8 URN5CHAR 6   UP  R    I     X           6   2   220 1.  1.  INSTRCTR
                                                                ROOM1
  9 URN5CHAR 6   D   G    I     X           6   2   30  1.  1.  INSTRCTR
                                                                ROOM1
                                                                I.SV
 10 URN5CHAR 6   HW  RF   L     X           1   1   60  1.  1.  L.ASV
 11 SERVROUT 7   GP  S    L     X           8   2   30  1.  1.  ANURN5
                                                                TSNR1
                                                                TSNR2
                                                                SIGGEN
                                                                LAB.MON
                                                                LAB
                                                                L.SV
 12 URN5CHAR 6   GP  R    I     X           6   2   110 1.  1.  INSTRCTR
                                                                ROOM1
 13 URN5CHAR 6   UP  R    I     X           6   2   220 1.  1.  INSTRCTR
                                                                ROOM1
 14 URN5CHAR 6   D   G    I     X           6   2   30  1.  1.  INSTRCTR
                                                                ROOM1
                                                                I.SV
 15 URN5CHAR 6   HW  RF   L     X           1   1   60  1.  1.  L.ASV
```

Fig. 23—Summary of course design (partial)

```
DO YOU WISH TO SEE THE SUMMARY OF RESOURCE CHARACTERISTICS (Y/N)? Y
**********************************************
**** SUMMARY OF RESOURCE CHARACTERISTICS ****
```

RESOURCE NAME	UNITS AVAIL.	CAPACITY	LEARNING EVENTS	SHARING L. E.
ANURN5	4	2	ALL	NONE
TSNR1	4	2	ALL	NONE
TSNR2	4	2	ALL	NONE
SIGGEN	4	2	ALL	NONE
INSTRCTR	2	6	MOST	27
		4	7	
		4	12	
		16	27	
EVALUATR	2	4	MOST	NONE
		6	29	
		6	57	
		6	84	
RM2.MON	1	12	ALL	ALL
RM3.MON	1	12	ALL	ALL
LAB.MON	2	6	ALL	ALL
ROOM1	2	6	ALL	13
				27
ROOM2	1	12	ALL	30
				32
				34
				36
				37
				41
				42
				46
				48
				51
				53
				55
ROOM3	1	12	ALL	58
				60
				62
				63
				67
				68
				72
				74
				77
				79
				82
LAB	1	20	ALL	ALL
I.SV	2	6	ALL	NONE
L.ASV	UNK	1	ALL	NONE
L.SV	34	1	ALL	NONE
P.SV	8	1	ALL	NONE

Fig. 24—Summary of resource characteristics

**** SUMMARY OF COURSE MINUTES AND EQUIVALENT DAYS ****

STUDENT CATEGORY	CLASS INSTRUCTION MINUTES	CLASS INSTRUCTION EQUIV. DAYS	HOMEWORK MINUTES	HOMEWORK EQUIV. DAYS
SLOW NON-E.E.TNG.	1455	4	240	4
SLOW E.E.TNG.	1303	3	220	3
FAST NON-E.E.TNG.	1340	3	240	4
FAST E.E.TNG.	1228	3	200	3

Fig. 25—Summary of course minutes and equivalent days

dent category. The final report (also not optional) is the "Summary of Media Usage" (Fig. 26) giving the name of each media type or system, the associated objective, subject matter type, student group or track, learning event type, teaching format, teaching agent, average minutes, and learning event number. The learning event number allows easy correlation with the RUM output.

DEFINE RUM PARAMETERS—PHASE 8

This phase, whose operation is illustrated in Fig. 27, collects numbers that control the length of the RUM simulation of course operation and the frequency with which intermediate reports on course operation are generated. The first three questions determine the simulated course operation time between reports, what simulation parameter will determine the end of the simulation (either number of graduates or course operation time), and the value to be used as a test for the end of the simulation. Whatever report interval is chosen, the RUM always produces a report for the end of the simulation.

The user should run initial simulations just long enough (say, for one or two course cycles at most) to determine whether there are any obvious deficiencies in course design. To insure that the run is short, it is better to use course operation time rather than number of graduates, in case there are unforeseen bottlenecks in the course. In initial runs, also, it is a good idea to ask for frequent reports to facilitate detailed analysis of course operation. Once the user is satisfied with the course design, he may want to make longer runs and decrease the frequency of reports. The modifications are easily made because the specifications occur in this last short phase.

The final set of questions in this phase is identical to the initial set in Phase 3, *Describe Student Population and Course Diversification*. They are repeated to permit rapid iterations involving these parameters. If necessary, the user should refer to the record of interaction with Phase 3 to refresh his memory.

At this point, the program transforms the course design for direct input to the RUM. The operation of the RUM analyzes the performance of the course. Also, RUM outputs may be combined with data from the UI course summary reports and available cost data for input to the Cost Model to estimate the cost of the course.

```
**********************************
**** SUMMARY OF MEDIA USAGE ****
```

MEDIA	OBJECT. NAME	SUBJ. MATTR	GROUP /TRK	L.E. TYPE	TEACH. FORMAT	TEACH. AGENT	AVG. MINUTES	L.E. NUM
I.SV	TESTEQP.	1	1	P	R	I	90	1
I.SV	TESTEQP.	2	1	P	R	I	60	3
I.SV	URN5CHAR	2	1	P	R	I	120	5
I.SV	URN5CHAR	6	1	D	G	I	30	9
I.SV	URN5CHAR	6	2	D	G	I	24	38
I.SV	URN5CHAR	6	3	D	G	I	24	64
I.SV	URN5CHAR	6	1	D	G	I	30	14
I.SV	URN5CHAR	6	2	D	G	I	24	43
I.SV	URN5CHAR	6	3	D	G	I	24	69
I.SV	TBSHPRIN	1	1	P	R	I	30	17
I.SV	TBSHPRIN	2	1	P	R	I	60	19
I.SV	FLTCHK..	1	1	P	R	I	30	22
I.SV	INSTALL.	1	1	P	R	I	30	24
I.SV	REVUE1..	6	1	R	R	I	30	26
I.SV	REVUE1..	6	3	R	G	I	30	81
L.ASV	TESTEQP.	1	1	HW	RF	L	20	2
L.ASV	TESTEQP.	2	1	HW	RF	L	20	4
L.ASV	URN5CHAR	2	1	HW	RF	L	20	6
L.ASV	URN5CHAR	6	1	HW	RF	L	60	10
L.ASV	URN5CHAR	6	1	HW	RF	L	60	15
L.ASV	TBSHPRIN	1	1	HW	RF	L	15	18
L.ASV	TBSHPRIN	2	1	HW	RF	L	15	20
L.ASV	FLTCHK..	1	1	HW	RF	L	15	23
L.ASV	INSTALL.	1	1	HW	RF	L	15	25
L.SV	TESTEQP.	1	2	HW	AF	L	20	31
L.SV	TESTEQP.	2	2	HW	AF	L	20	33
L.SV	TESTEQP.	2	3	HW	AF	L	20	59
L.SV	URN5CHAR	2	2	HW	AF	L	20	35
L.SV	URN5CHAR	2	3	HW	AF	L	20	61
L.SV	URN5CHAR	6	2	GP	AF	L	95	36
L.SV	URN5CHAR	6	2	HW	S	L	60	39
L.SV	URN5CHAR	6	3	GP	AF	L	95	62
L.SV	URN5CHAR	6	3	HW	S	L	60	65
L.SV	SERVROUT	7	1	GP	S	L	30	11
L.SV	SERVROUT	7	2	GP	S	L	30	40
L.SV	SERVROUT	7	3	GP	S	L	30	66

Fig. 26—Summary of media usage (partial)

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**** SIMULATION REPORT SPECIFICATIONS ****
WHAT ARE THE NUMBER OF HOURS BETWEEN SIMULATION REPORTS? 768
SIMULATION END OPTION
   0- END AFTER A SPECIFIED NUMBER OF COURSE HOURS
   1- END AFTER A SPECIFIED NUMBER OF STUDENTS HAVE GRADUATED
WHICH OPTION DO YOU WANT TO USE (0 OR 1)? 0
NUMBER OF HOURS?  768
*******************************************
**** STUDENT POPULATION REDEFINITION ****
THE USER MAY WISH TO ENTER NEW VALUES FOR THE NEXT QUESTIONS
REFER TO V A, WORKSHEET III, TABLE A
DO STUDENTS ARRIVE AT FIXED INTERVALS (Y/N)? Y
DO STUDENTS ARRIVE IN GROUPS OF FIXED SIZE (Y/N)? Y
WHAT IS THE TIME BETWEEN ARRIVALS (HRS)? 30
WHAT IS THE GROUP SIZE? 8
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Fig. 27—Define resource utilization model operation